AD-A269 165

Emergency Plan for the Locks and Dams at St. Anthony Falls

Minneapolis, Minnesota

March, 1987

US Army Corps of Engineers
St. Paul District

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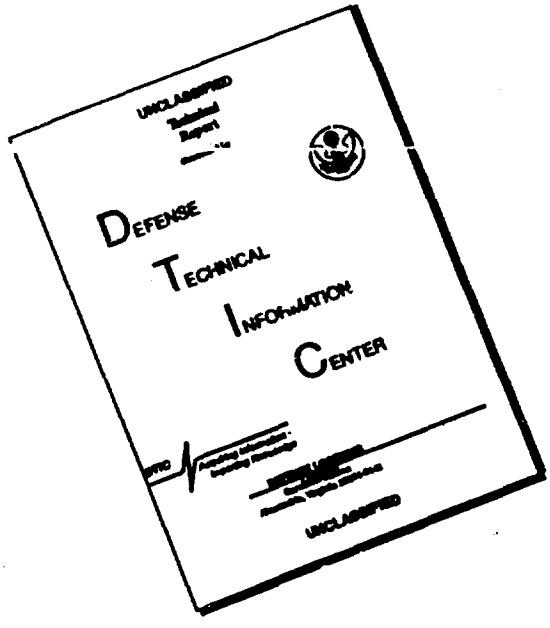

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This plan implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for actions to identify and mitigate or respond to various types of emergencies which, while rare, could occur in the operation of the St. Anthony Falls locks and dam.

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CENCS-ED-M(11-2-240A)	Emergency Plan Lock and Dam St. Anthony Falls

TO	FROM	DATE	CMT 1
See Attached Distribution	CENCS-ED-M	26 April 1988 Blackstone/429	

The copies of completed emergency plan for lock and dam SAF is enclosed for your reference. This report implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for identifying, mitigating, or responding to various types of emergencies which, although unlikely, could occur during the operation of the dam.

Please contact me at (612) 220-0429 with questions or comments or to request additional copies.

1 Encl

JOHN F. BLACKSTONE
Project Manager

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Dated
26 April 1988

DEPARTMENT OF THE ARMY
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS
536 SOUTH CLARK STREET
CHICAGO, ILLINOIS 60605-1592

REPLY TO
ATTENTION OF

CENCD-ED-WH (1130-2-419)

4 FEB 1988

MEMORANDUM FOR: Commander, St. Paul District, ATTN: CENCS-ED-WH

SUBJECT: Review and Approval of the Emergency Plans for Pine River Dam, Red Lake Dam, Highway 75 Dam, Lock and Dam 1 and St. Anthony Falls Lock and Dam

1. We have reviewed the subject emergency plans and have approved these plans with the exception of the plan for the Pine River Dam.

2. Since the simplified flood emergency plan for the Pine River Dam shows that failure significantly affects the downstream area, it will be necessary to prepare a detailed plan for this structure. Please provide us a schedule for completion of this plan no later than 27 February 1988.

3. References:

a. CENCS-ED-M Memorandum of 23 September 1987, subject: Emergency Plans for Cross Lake (Pine River Dam), Red Lake Dam and Highway 75 Dam.

b. CENCS-ED-M Memorandum of 19 June 1987, subject: Emergency Plans for Lock and Dam 1 and St. Anthony Falls Lock and Dam.

FOR THE COMMANDER:

Zane M. Goodwin

ZANE M. GOODWIN, P.E.
Chief, Engineering Division

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DEPARTMENT OF THE ARMY
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REPLY TO
ATTENTION OF

NCSED-M (350-3-2A) 9 JUN 1987

MEMORANDUM FOR: Commander, North Central Division, 536 South Clark Street, Chicago, Illinois 60605-1592

SUBJECT: Emergency Plans for Lock and Dam 1 and St. Anthony Falls

1. Subject reports are submitted in accordance with Engineer Regulation 1130-2-419.

2. These reports implement the Corps program to prepare emergency plans for all Corps dams. It provides a guide for identifying, mitigating, or responding to various types of emergencies, which, although unlikely, could occur during the operation of lock and dam 1 and St. Anthony Falls.

Stanley R. Kempula, acting for
JOSEPH BRIGGS
Colonel, Corps of Engineers
Commanding

2 Encls (2 cys)
1. EAP, lock and dam 1
2. EAP, St. Anthony Falls

EMERGENCY PLAN
FOR
THE LOCKS AND DAMS AT ST. ANTHONY FALLS

MINNEAPOLIS, MINNESOTA

Prepared by the
U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT

March, 1987

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EMERGENCY PLAN
FOR
THE LOCKS AND DAMS AT ST. ANTHONY FALLS
MINNEAPOLIS, MINNESOTA

1. INTRODUCTION

Part of the land surrounding the St. Anthony Falls locks and dams that would be inundated by the Standard Project Flood is not in Federal ownership. In addition, most of the land under Federal control is also public use land. The possibility, therefore, exists that high water levels could cause a hazard to life and property in the project area and surrounding lands. In addition, a failure of the dam or embankment during normal pool, low flow conditions, could result in the sudden release of a large volume of water from the upper and/or intermediate pools, which would cause a hazard to life and property in the project area and surrounding lands.

a. Purpose

This plan implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for actions to identify and mitigate or respond to various types of emergencies which, while rare, could occur in the operation of the St. Anthony Falls locks and dam. Specific information on emergency actions to be taken is provided in the following appendices:

1) Appendix A, Emergency Identification Subplan
2) Appendix B, Emergency Operations and Repair Subplan
3) Appendix C, Emergency Notification Subplan
4) Appendix D, Inundation Maps and Hydraulic Data

b. Applicability

The emergency plan is applicable to all Corps elements and field offices concerned with operation of St. Anthony Falls locks and dam.

c. References

1) ER 1130-2-419, "Dam Operations Management Policy", U.S. Army Corps of Engineers, 9 April 1982.

2) Director of Civil Works multiple letter dated 20 March 1978, subject: Evacuation Plans for Areas Downstream of Corps dams and Corps/State Cooperation on Safety Review of Corps Dams.

3) Water Resource Development: Minnesota (U.S. Army Corps of Engineers, North Central Division, January 1979).

4) Flood Emergency Plan for Lock and Dam 2. Hydrology and Hydraulics Appendix A (U.S. Army Corps of Engineers, St. Paul District, 1983).

5) Flood Hydrograph Package, HEC-1 (U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis California, September 1981).

6) Runoff from Snowmelt, EM 1110-2-1406 (U.S. Army Corps of Engineers, 5 January 1960).

7) Probable Maximum Precipitation Estimates and Snowmelt Criteria for the Upper Mississippi River Basin in Minnesota and the Fox-Wolf Rivers in Wisconsin (National Weather Service, 1981).

8) Seasonal Variation of 10-Square Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, HMR-53 (U.S. Department of Commerce, Silver Spring, MD, April 1980).

9) Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, HMR-51 (U.S. Department of Commerce, Washington, DC, June 1978).

10) Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian, HMR-52 (U.S. Department of Commerce, Washington, DC, August 1982).

11) Computer Program, Probable Maximum Storm HMR-52 (U.S. Army Corps of Engineers, Hydrologic Engineering Center. Davis California, November 1982).

12) Standard Project Flood Determination, EM 1110-2-1411 (U.S. Army Corps of Engineers, Washington, DC, March 1965).

13) Mississippi River Nine-Foot Channel Navigation Project Reservoir Regulation Manual, Appendix SAF, St. Anthony Falls Upper Lock and Lower Lock and Dam, Minneapolis, Minnesota (U.S. Army Corps of Engineers, St. Paul District, August, 1975).

14) Mississippi River Nine-Foot Channel Navigation Project, Reservoir Regulation Manual, Appendix 1, Lock and Dam 1, Minneapolis, Minnesota. (U.S. Army Corps of Engineers, St. Paul District, September 1983).

15) Mississippi River Nine-Foot Channel Navigation Project Reservoir Regulation Manual, Appendix 2, Lock and Dam 2, Hastings, Minnesota. (U.S. Army Corps of Engineers, St. Paul District).

16) Upper Mississippi River, Water Surface Profiles, River Mile 0.0 to River Mile 847.5. (Upper Mississippi River Basin Commission and U.S. Army Corps of Engineers, Rock Island District).

17) Master Regulation Manual for Mississippi River Nine-Foot Channel Navigation Projects. (U.S. Army Corps of Engineers, St. Paul District, September 1969).

18) Research Document No. 19, Example Emergency Plan for Blue Marsh Dam and Lake. (U.S. Army Corps of Engineers, St. Paul District, August 1983).

19) Earth Manual, Second Edition. (U.S. Department of the Interior, Water and Power Resources Service Reprint - 1980).

20) FM 5-35 Engineer's Reference and Logistical Data, Department of the Army, 1971.

21) ER 500 1-1, Emergency Employment of Army and other resources, National Disaster Procedures, dated 9 January 1978).

22) Flood-Hydrograph Analyses and Computations, EM 1110-2-1405 (U.S. Army Corps of Engineers, 31 August 1959).

23) "Mississippi River Flood Plain Information and Management, Mile 815.2 to Mile 847.7" (Minnesota Department of Natural Resources, 1972).

24) Minneapolis Flood Insurance Study.

d. Scope

This plan addresses emergencies related to above normal headwater levels and/or rapid release of large volumes of water past the dam. It covers identification of impending or existing emergencies, notification of other parties concerning impending or existing emergencies, and emergency operations and repairs. Areas potentially affected by emergencies are identified for the cases of Standard Project Flood without dam failure; Standard Project Flood with dam failure; and dam failure at normal pool level.

e. Datum

All elevation contained in this report have the designation National Geodetic Vertical Datum (NGVD) 1912 adjustment.

f. Definitions

1) Pre-Emergency

A "pre-emergency" condition is one in which some impending or existing threat to the safe operation of the dam and headwater is recognized but no significant hazard to life or property is expected to occur. Notification of other Corps Offices is required upon declaration of a pre-emergency condition.

2) Emergency

An "emergency" condition is one in which the occurrence of a significant hazard to life or property is possible or certain to occur. Conditions justifying declaration of an emergency condition may be imminent, such as breach of the dam or predicted large inflows. Warnings to evacuate are required upon declaration of an emergency condition.

2. DESCRIPTION OF PROJECT AREA

a. Location

The St. Anthony Falls upper lock and lower lock and dam are located on the Mississippi River at river mile 853.8 and 853.4, respectively, above the mouth of the Ohio River near downtown Minneapolis, Minnesota, as shown in Plates 1 and 2. The upper lock is just downstream of the Third Avenue bridge and on the south side of St. Anthony Falls. The lower lock and dam is 0.4 miles downstream and just upstream of the Interstate Highway 35W and Tenth Avenue bridges.

b. Topography

The topography of the area is typical of glacial effects with gently rolling hills and scattered lakes. Below St. Anthony Falls the Mississippi River cuts a gorge approximately a quarter mile wide with 100 to 150-foot high bluffs on either side. Approximately nine miles downstream the Minnesota River joins the Mississippi River and the channel widens with a floodplain up to 2 to 3 miles wide.

c. Geology

The Minneapolis-St. Paul region is one of considerable geologic interest. The three main rivers, the Mississippi, Minnesota, and St. Croix, have cut through the surficial deposits and exposed the bedrock. Glaciers which repeatedly invaded the region have completely altered the surface features. The 7-mile upstream migration of St. Anthony Falls from Fort Snelling to its present location furnishes one of the most reliable estimates in this portion of North America of the length of time since the last invasion by glaciers. This migration was a result of the river eroding the St. Peter sandstone, thereby undercutting the Platteville limestone formation which has an average thickness of 30 feet. The falls were stabilized by the construction of the dam at the present location of the St. Anthony Falls.

Below the falls, the Mississippi River is cradled in the St. Peter sandstone formation. The bluffs adjacent to lock and dam 1 clearly reveal the Platteville formation under approximately 5 feet of top soil. The underlying St. Peter sandstone sublayer is 160 feet thick. Beneath the St. Peter formation lies 125 feet of dolomite and several layers of sandstone proceeded by shale to the

depth of about 2,200 feet. The granite formations below this point are geologically older or of the Pre-Cambrian period.

d. Climate

The Upper Mississippi Basin has a marked continental climate. The Minneapolis-St. Paul area is characterized by cold, humid winters and hot summers. The maximum, average, and minimum temperatures and annual precipitation are 104, 45 and -33 degrees Fahrenheit and 42, 27, and 12 inches, respectively.

e. Description of Upper Mississippi River Basin to Lock and Dam 1

The Mississippi River, first called "Father of Waters" from its beginning at Minnesota's Lake Itasca, meanders north to Lake Bemidji along a lazy winding course for about 80 miles (3). Downstream from Lake Bemidji, for a hundred miles it runs east, stringing together a chain of azure lakes. From there it flows through swamps, lakes and second growth pine forests, down small rapids and between rising banks on its journey to the Falls of St. Anthony at Minneapolis. Lock and dam 1, also known as the Ford Dam, is located approximately 5.9 miles downstream of St. Anthony Falls. A basin map is shown on Plate 1, and drainage areas at selected points along the Mississippi River are presented in Table 1.

TABLE 1
MISSISSIPPI RIVER DRAINAGE AREAS ABOVE MINNEAPOLIS

Station	Drainage Area (sq. mi.)	River Mile
Mississippi River at Aitkin	6,140	1055.9
Mississippi River at Royalton	11,600	956.0
Crow River at Rockford	2,520	Enters at 879.2
Mississippi River at Anoka	19,100	864.8
Mississippi River at St. Anthony Falls	19,680	853.8

3. DESCRIPTION OF PROJECT FEATURES

a. St. Anthony Falls Upper Lock and Lower Lock and Dam

The lower St. Anthony Falls lock is located on the Mississippi River in downtown Minneapolis, Minnesota, as shown on Plates 1 and 2. It is a gravity type structure begun in 1950 and completed in 1956. It was placed on bedrock on the right bank of the river downstream of the original, fixed crest lower dam which has been removed. The main lock chamber is 56 feet x 400 feet. Project pool and tailwater are at elevations 750.0 feet and 725.1 feet, respectively, resulting in a normal lift of 24.9 feet. The upper

gate of an auxiliary lock has been provided so that a second lock may be added in the future.

The lower gate in the main lock is a miter gate. The upper gates in both the main and auxiliary lock chambers are tainter gates which can be used to aid in discharging high flows in addition to being used in locking operations. For the passage of navigation, the upper gate in the open position is submerged.

The lower St. Anthony Falls dam, also completed in 1956, is a gravity type with three tainter gates adjoining the auxiliary lock. A steel plate girder service bridge spans the tainter gates, lock chambers, and storage yard and provides for the operation of an electric locomotive crane. A non-overflow gravity type section to provide closure for the lower dam was placed on bedrock connecting the end of the tainter gate section with the lower dam power station. Plan and cross-section views of the lower lock and dam are shown on Plate 3 and additional pertinent data is presented in Table 2.

The upper St. Anthony Falls lock is located 0.4 miles upstream of the lower lock, as shown on Plate 2. This gravity type structure supported on a rock foundation was begun in 1959 and completed in 1963. The lock excavation cut through the existing horseshoe-shaped upper dam near the right bank of the Mississippi River on Upton island. The lock chamber, like the lower lock, is 56 feet x 400 feet. The normal lift is 49.2 feet with the project pool and tailwater elevations of 799.2 feet and 750.0 feet, respectively. Alterations to the upper dam, which consists of eight sections, were made to raise the lowest crest to elevation 796.5 feet. This reduced cross currents in the upper lock approach. Flashboards are used to maintain a pool elevation of 799.2 feet. The stone arch bridge crosses the lower approach to the upper lock. One pier and two spans were replaced by a deck type steel truss to provide adequate clearance for navigation. Both the upper and lower lock gates are miter gates. Below the upper gate bay, a submergible tainter gate is also provided, allowing the upper lock to be used in passing high flows, ice and debris.

Plan and cross-section views of the upper lock and the upper dam are shown on Plates 4 and 5, respectively. Additional pertinent data is presented in Table 2.

b. Public Use Areas

In addition to commercial navigation uses, the upper, intermediate, and lower pools are used by the general public for recreation. (The upper pool is the impounded water upstream of the upper lock and dam. The intermediate pool is the water between the upper and lower locks and dams. The lower pool is the tailwater of the lower lock.)

TABLE 2

PERTINENT DATA

LOWER LOCK AND DAM - GENERAL

Project Intermediate Pool	Elev. 750.0 Feet
Project Lower Pool (with 2 feet of flashboards on dam 1)	Elev. 725.1 Feet
Lift	24.9 Feet
River Miles Above Ohio River	853.4
Drainage Area	19,680 sq. miles
Pool Area at Project Pool Elevation	50 acres
Maximum Stages of record	(17 April 1965)
Intermediate Pool	Elev. 751.42 Feet
Lower Pool	Elev. 739.02 Feet
Discharge	91,000 cfs

LOWER LOCK

Width (main and auxiliary locks)	56 Feet
Length (main lock)	400 Feet
Length (auxiliary lock)	Upper gate only
Top of Walls	Elev. 755.0 Feet
Top of Upper Sill (tainter gate)	Elev. 736.3 Feet
Top of Lower Sill (miter gate)	Elev. 712.8 Feet
Floor	Elev. 711.8 Feet
Upper Gate (tainter gate)	56' x 15.2' damming height
Lower Gate (miter gate) 2 leaves	Each 32"2" x 39'8" damming height
Lock Closed to Navigation	When Discharge = 40,000 cfs*
Number of Emergency Bulkheads (3'0" x 6'0" x 59'9-1/2")	13

NOTE: All bulkheads for both lower lock and dam and upper lock are stored at lower lock.

LOWER DAM

Movable Dam Section: 3 tainter gates	Each 56' x 20.5'
Top of Sill	Elev. 731.0 Feet
Apron, Length	65.5 Feet
Apron, Top	Elev. 710.0 Feet
Service Bridge, Base of Rail	Elev. 786.85 Feet
Electric Locomotive Crane	25 Ton Capacity, 50' Boom
Number of Emergency Bulkhead Storage Trucks (5'7-1/8" x 8'4")	10

* This criteria may be waived when the District determines it is safe to continue navigation.

TABLE 2 (CONTINUED)

UPPER LOCK

Project Upper Pool (with flashboards on Horseshoe Dam)	Elev. 799.2 Feet
Project Intermediate Pool	Elev. 750.0 Feet
Lift	49.2 Feet
River Miles Above Ohio River	853.8
Maximum Stages of Record	(17 April 1965)
Upper Pool	Elev. 803.43 Feet
Intermediate Pool	Elev. 751.42 Feet
Discharge	91,000 cfs
Width	56 Feet
Length	400 Feet
Top of Walls	Elev. 806.0 Feet
Top of Upper Sill (miter and tainter gate)	Elev. 783.5 Feet
Top of Lower sill (miter gate)	Elev. 736.3 Feet
Stilling Basin (river side of river wall)	30' x 49'
Stilling Basin, Top	Elev. 736.0 Feet
Upper Gate (miter gate) 2 leaves	Each 32'2" x 20'0" damming height
Upper Gate (tainter gate)	56' x 15.7' damming height
Lower Gate (miter gate) 2 leaves	Each 32'2" x 67'2-3/8" damming height
Lock Closed to Navigation	When Discharge = 40,000 cfs*

HENNEPIN ISLAND POWER PLANT

Date Built	1908
Owned and Operated By	Northern States Power Company
Type of Operation	Run-of-the-River (No peaking)
Number of Units	5 units
Nominal Head	49.2 ft.
Total Discharge Capacity	3800 cfs
Total Power Output Capacity	12,500 KW

LOWER DAM POWER PLANT

Date Built	1895
Owned and Operated By	Northern States Power Company
Type of Operation	Run-of-the-River (No peaking)
Number of Units	10 units
Nominal Head	24.9 ft.
Total Discharge Capacity	5000 cfs
Total Power Output Capacity	8000 KW

* This criteria may be waived when the District determines it is safe to continue navigation.

There are several parks and undesignated public recreation areas upstream of St. Anthony Falls as well as along the east and west river roads downstream. The size and location of these public use areas relative to St. Anthony Falls are given in Table 3. The upper lock has facilities allowing public access to view the locking procedures and the surrounding area.

Recreational use including boaters, fishers, and others averages approximately 1350 lockages per year at St. Anthony Falls locks.

c. Gages and Instrumentation

Water level recorders are installed on the upper, intermediate, and lower pools to provide a continuous record of the water stages at the St. Anthony Falls project. In addition to the recorders, staff gages are located to enable visual measurement of the headwater and tailwater for both the upper and lower locks. Since the locks are so close together, the readings for the pool upstream of the lower lock (the intermediate pool) are also used for the tailwater of the upper lock. Pool and tailwater elevations, gate openings, discharges, gate changes, precipitation, temperature, ice and snow conditions are recorded every four hours in the daily log sheet. One log sheet, kept at the lower lock, is used for both the upper and lower projects.

TABLE 3

PUBLIC USE AREAS
POTENTIALLY AFFECTED BY ST. ANTHONY FALLS LOCKS AND DAM

Upstream Areas (Upper Pool)	Distance Relative to St. Anthony Falls (miles)	Area (acres)
Coon Rapids Dam Regional Park	10	600
Anoka County Riverfront Regional Park	5	140
North Mississippi Park	3.6	-
Marshall Terrace Park	2.7	-
Gluek Park (on east bank)	2.1	-
Nicollet Island Park	0.2	-
Portion of Main Street Park	0	-
Upper lock public area	0	-
Downstream Areas		
Central Mississippi Riverfront Regional Park (includes Main Street and Hennepin Island Parks)	0-3.0	50
Mississippi Gorge Regional Park (includes East River Flats and Riverside Parks)	3-6.5	480
Lock and Dam 1 Visitor Promenade	6.5	-
Minnehaha Regional Park	6.5	170
Hidden Falls-Crosby Farm Regional Park	6.5-10	610

d. Operations and Maintenance

The St. Anthony Falls locks and dam are operated by the St. Paul District Corps of Engineer's Construction Operations Division, under the Lock and Dam section of the Project Operations Branch. The basic organization for operating the locks and dam includes the following personnel: area lockmaster, lockmaster, assistant lockmaster, 8 head lock and dam operators, 8 lock and dam operators, an equipment repairman, and 3 temporary employees. This workforce except for the temporary employees is maintained throughout the year. During the navigation season, at least three employees are on duty at all times, but during the winter months on night shifts and holiday weekends, only two employees are on duty. It is during the winter months that most of the repair and maintenance work is accomplished, and the employees take their annual leave.

The basic plan of operation for the St. Anthony Falls project differs from the basic plan of operation for the navigation projects in the St. Paul District as detailed in paragraph D-15 of "The Master Regulation Manual", reference 17. The project pools of both the upper and lower structures are maintained at the dam sites instead of at a theoretical control point. Also both pools, besides providing sufficient depth for navigation, store water to generate electricity at the NSP (Northern States Power Company) hydropower plants at Hennepin Island and the lower dam. See reference 13 for details of the NSP plan of control for the St. Anthony Falls Project. A general discussion is given below.

The upper pool, while open to navigation, is regulated by the discharge through the Hennepin Island Hydro Plant and by the flow over the Horseshoe Dam. After the flows of the spring break-up have subsided to the Hennepin Island plant capacity (approximately 3,800 cfs), the power company installs flashboards atop the overflow section of the Horseshoe Dam so that project pool, elevation 799.2, may be maintained. The flashboards are designed to be automatically removed by ice action in the spring break-up or by water pressure if the pool should rise to elevation 801.0.

If the flow in the river reaches 40,000 cfs, all navigation is halted at the St. Anthony Falls project according to regulations. (The District may waive this criteria if it is safe to continue navigation.) This is the only period during which the Corps of Engineers takes part in the regulation of the upper pool, as the upper and lower miter gates of the upper lock are withdrawn into the gate recesses, and the tainter gate is placed into operation to aid in maintaining project pool. During the April, 1965 flood of record, the peak flow at St. Anthony Falls was 91,000 cfs with an estimated 12,000 cfs passing through the upper lock.

The intermediate pool is regulated by the power plant at the lower dam and the gates of the lower dam. The total flow in the

Mississippi River at the St. Anthony Falls project is obtained by calling the United States Geological Survey telemark gage near Anoka, Minnesota. The balance of the flow not required at the lower dam power station (plant capacity is 5,000 cfs) must be discharged through the lower dam. Whenever the tainter gates in the Corps of Engineers' lower dam must be used to aid in maintaining project pool elevation, a set method of operating the gates has been adopted (see reference 13). In general, the three tainter gates of the dam and the tainter gate in the auxiliary lock are opened in increments for flows less than 40,000 cfs. For flows greater than 40,000 cfs, the main lock gate shall be raised as necessary until a total discharge of 50,000 cfs (10,000 cfs per gate) is reached. For any further increases in discharge, all additional gate openings shall be divided equally among the five gates until the operating head becomes less than 1.0 foot. At this head all tainter gates shall be raised out of the water to their highest elevation. Open river conditions will be in effect in the intermediate pool and the lower dam will be out of control.

Because of its small capacity, the intermediate pool is quickly affected by lockages and changes in power demand. Maintaining project pool, elevation 750.0, may require frequent tainter gate changes. Plates 13 and 14 provide the discharges for the lower dam tainter gates, open in the normal and submerged positions respectively. See reference 13 for further detail.

The winter operation of the locks and dams is discussed in references 13 and 17. The winter inflows are usually below power plant capacity, and it is very seldom necessary to use the discharge facilities at the upper or lower Corps of Engineers' projects after the close of the navigation season.

4. POTENTIALLY AFFECTED PROJECT AREAS

Potentially affected project areas are all lands under the control of the Corps of Engineers potentially affected by emergencies at the St. Anthony locks and dam. This would include the facilities at the locks and dam and the 9-foot channel in the upper and intermediate pools. Locks and dams downstream may be affected by possible increases in flows during emergencies at St. Anthony Falls.

5. POTENTIALLY AFFECTED NON-PROJECT AREAS

Potentially affected non-project areas are all areas not presently under the control of the Corps of Engineers and potentially affected by emergencies at the St. Anthony Falls project. This would include the cities of Minneapolis and St. Paul and the public use areas discussed in Section 3b, except for the public use facilities at the locks. If the 9-foot channel in the upper and intermediate pools were lost, all commercial and recreational vessels wishing to proceed upstream of pool 1, and all vessels located in the upper and intermediate pools would be affected.

6. POTENTIAL CAUSES OF AN EMERGENCY

The potential causes of an emergency affecting the operation or safety of the St. Anthony Falls project which were selected for planning include:

a. Structural Damage
b. Sabotage
c. Extreme Storm
d. Excess Seepage
e. Failure Due to Scouring

A brief discussion of each of the above items follows.

a. Structural Damage

There is a chance of structural damage to the dams caused by some remote incident such as a tow boat with loaded barges striking the structure, or earthquake. The result could be a breach releasing the water in the upstream pool. Structural failure due to undetected and/or uncorrected structural deterioration is also possible.

b. Sabotage

A potential exists that operation of the lock and dam could be affected by sabotage, disrupting communications, disabling controls or equipment, breaching the dam or various combinations of the foregoing.

c. Extreme Storm

An extreme storm could occur in the immediate area and in the watershed upstream. The resulting runoff could cause a high headwater and large discharges over the dam. The potential for mitigating any problems depends on the severity and on other circumstances such as the possibility of power outages, communication difficulties and blocked transportation routes.

d. Excessive Seepage

Excessive seepage beneath the dam could cause uplift pressure and erode supporting material of the structure. If the foundation failed as a result of this damage, there is a chance of a breach in the structure causing a large discharge.

e. Failure Due to Scouring

Scour can be a problem downstream of the overflow structure. If the velocity of the water from the dam is not dissipated in the stilling basin, the material in the river bed may be eroded, undermining and exposing the foundation and possibly causing a breach of the structure.

7. COMPUTATION OF OUTFLOW HYDROGRAPHS

The Probable Maximum Flood was determined at Minneapolis using the most critical centering of the precipitation pattern and "season" of the year. Seasons were considered as the hydrometeorological conditions prevailing prior to the 15 March and the all-season storm.

The HEC-1 Upper Mississippi River basin flood forecast and routing model as developed by the St. Paul District was used to calculate the runoff hydrographs. Only three subbasins upstream of Anoka were used as shown on Plate 1. The unit hydrographs shown on Plate 6 are taken from the flood routing model (derived from historic flood events) but peaked 50 percent using the methods in EM 1110-2-1405, Flood Hydrograph Analyses and Computations (22). In applying the routing model, runoff from the portion of Subbasin C upstream of Lake Winnibigoshish is assumed to be stored in the lakes and reservoirs except for a base flow.

The 15 March areal PMP (Probable Maximum Precipitation) for the Mississippi River Basin above Minneapolis was obtained by multiplying the corresponding 10-square-mile PMP obtained from HMR-53 (8) by the ratio of the areal PMP to the 10-square-mile PMP from Figures 10, 12 and 14 of Reference 7. The all season areal PMP was obtained using HMR-51 (9). Plates 7 and 8 present the 15 March and all season PMP depth-area curves.

The procedures in HMR-52 (10) and computer program HMR-52 (11) were used to determine the storm area size and orientation that maximized the average precipitation depth for approximately 24 storm centerings, with the five shown in Table 4 being representative. Having determined that the Area D_1 plus D_2 centering is critical for the all season PMP, it was also used for the 15 March PMP, resulting in the temporal distribution by subbasin presented in Table 5.

Snowmelt was computed using criteria set forth in EM 1110-2-1406, Runoff From Snowmelt (6) and the Upper Mississippi River Basin PMP study (7). The critical snowpack and sequences of temperature, dew points, and winds 10 days prior to the spring PMP storm were obtained from Reference 7. A more detailed presentation of the analysis is available in the June, 1984 St. Croix River Basin Study (unpublished). The 15 March event was assumed to be the critical snowmelt event as determined from previous analyses within the Upper Mississippi River Basin, precluding the need to analyze the 30 March and 15 April events. An average snowpack of 10.9 inches was used for the March 15 event. The snowmelt for Subbasin C extends into the first days of rainfall. Table 6 lists the snowmelt excess after the 0.02 inches/hour loss and retention in the snowpack is considered and the rainfall excess for the 15 March PMP after a 0.02 inches/hour loss.

Flood discharges were determined for the critical centering for both the all-season PMP and the 15 March PMP with snowmelt. Initial losses of 4.0 inches and 3.0 inches and uniform loss rates of 0.10 inch/hour and 0.02 inch/hour were used for the all-season and 15 March events,

TABLE 4

PROBABLE MAXIMUM STORM SCENARIOS

PMP Center	Season	HMR-52 Results Orientation*	Storm Area mi^2
Entire Drainage Above Minneapolis	All Season	210°	15,000
Area C	All Season	210°	20,000
Area D_1	All Season	210°	20,000
Area D_2	All Season	177°	20,000
Area D_1 plus D_2	All Season	205°	20,000
Area D_1 plus D_2	15 March	205°	20,000

*The preferred orientation was 251° (10).

TABLE 5

TEMPORAL DISTRIBUTION FOR 15 MARCH PMP
(inches)

Subbasin	Time-Hours 12	24	36	48	60	72	Total
C	.31	.36	.45	.59	1.32	1.01	4.04
D_1	.35	.42	.51	.67	1.79	1.21	4.95
D_2	.42	.50	.62	.82	2.64	1.53	6.53

TABLE 6

PROBABLE MAXIMUM SNOWMELT AND RAINFALL EXCESS*
(inches)

12-Hour Period Before or After PMP Starts	Subbasin D_2		Subbasin D_1		Subbasin C	
	Snow	Rain	Snow	Rain	Snow	Rain
17	0					
16	.23					
15	.06					
14	.38					
13	.16		0			
12	.37		.14			
11	.26		.03			
10	.34		.13			
9	.48		.09			
8	.38		.18			
7	.73		.20			
6	.38		.20			
5	1.00		.35			
4	.34		.35		0	
3	0		1.06		.15	
2	0		.87		.70	
1	0		1.59		1.20	
Rain Starts						
1		0.18		0.11	2.11	.07
2		0.26		0.18	1.90	.12
3		0.38		0.27	.71	.21
4		0.58		0.43		.35
5		2.40		1.55		1.08
6		1.29		0.97		.77

*Values shown are after a 0.02 inch/hour loss and retention in the snowpack are considered.

respectively, as determined in previous studies. The 15 March PMP runoff was found to be critical. To compute the PMF (Probable Maximum Flood), the 15 March PMP with prior snowmelt was applied to the watershed model. The initial losses are not applied to the primary drainage area, estimated to consist of 50 percent of Subbasin C and 80 percent of Subbasins D_1 and D_2. These estimates are from previous studies in the watershed and were checked for sensitivity. The PMF hydrograph on the Mississippi River at Minneapolis (Plate 9) was determined to peak at 286,000 cfs, including a total baseflow of 17,000 cfs.

Prior studies indicate that the SPF (Standard Project Flood) discharges are generally equal to 40 to 60 percent of the Probable Maximum Flood for the same basin (12). The SPF hydrograph (Plate 10) for this study was taken as 55 percent of the PMF, resulting in a peak discharge of 157,000 cfs at Minneapolis.

8. DAM FAILURE ANALYSIS

a. Introduction

This section presents the SPF and normal pool failures of the St. Anthony Falls project in Minneapolis, Minnesota. An examination of the hydrologic and hydraulic characteristics of the locks and dams indicates that neither dam break scenario will have a significant effect on water levels beyond a short distance downstream of the structures.

b. Methodology

The computer program HEC-1 (5) was used to model the breaches and to route all flows through the reservoir and downstream river reaches. Reservoir routing was accomplished at the upper and lower St. Anthony Falls dams (RM (river mile) 853.8 and 853.4) using the Modified Puls method with reservoir storage, elevation, and outflow characteristics determined from data in the St. Anthony Falls Reservoir Regulation Manual (13).

Channel routing also used the Modified Puls method with the storage-elevation-discharge relationship determined through normal depth channel routing. The cross-sections used were from Mississippi River Flood Plain Information and Management (23), the Minneapolis Flood Insurance Study (24), and soundings of the reach upstream of USAF (upper St. Anthony Falls) to approximately the 37th Avenue bridge (RM 857.8). The water surface profiles were modified when appropriate to parallel historical water surface profiles and to match the rating curve for lock and dam 1 as given in its Reservoir Regulation Manual (14).

For both the SPF and the normal pool dam breaks, the parameters describing the dam breach were chosen to create the most critical breach reasonably possible.

The parameters for the SPF breach are shown below in Table 7. For the SPF dam breach, Sections 7 and 8 of the upper dam above the main St. Anthony Falls spillway were failed when the upper pool and discharge were at their peak. The non-overflow section of the LSAF (lower St. Anthony Falls) dam was failed 12 minutes later in order to produce the maximum downstream discharge. (Refer to Plates 2 through 5 for plans and sections.) It was assumed that the upper and lower locks were being used as spillways and that all of the lower dam gates were full open during the SPF.

TABLE 7
SPF DAM BREAK PARAMETERS

Parameters	USAF	LSAF
Elevation of Breach Bottom	783.0 ft.	731.1 ft.
Breach Bottom Width	520 ft.	100 ft.
Breach Side Slopes	Vertical	Vertical
Time for Breach Development	0.2 hours	0.1 hours
Pool Elevation at Time of Failure	806.4 ft.	758.2 ft.

The breach parameters for the normal pool dam break are shown in Table 8. The breach parameters and mode of failure are assumed to be the same as for the SPF dam break. The conditions assumed at upper St. Anthony Falls are flashboards in place and a discharge of 7,500 cfs. The lower St. Anthony Falls dam breach is assumed to begin 27 minutes after the upper dam breach when the headwater on the lower dam peaks. It is assumed that all of the lower dam gates remain closed throughout the failure sequence and that the discharge is limited to 7,500 cfs passing through the powerhouse until the lower dam begins to be overtopped.

TABLE 8
NORMAL POOL DAM BREAK PARAMETERS

Parameters	USAF	LSAF
Elevation of Breach bottom	783.0 ft.	731.1 ft.
Breach Bottom Width	520 ft.	100 ft.
Breach Side Slope	Vertical	Vertical
Time for Breach Development	0.2 hours	0.1 hours
Pool Elevation at Time of Failure	799.6 ft.	755.0 ft.

c. Results

SPF Dam Failure The SPF outflow hydrographs for the with-failure and without-failure conditions are shown on Plate 10. The failure of both dams results in an increase in discharge immediately downstream of lower St. Anthony Falls from 157,000 cfs to 214,000 cfs. Because of the relatively low storage volume behind the dams, the with-failure hydrograph returns to the without-failure hydrograph in approximately 1/2 hour, causing it to appear as a spike on Plate 10. This spike peak is rapidly attenuated as it moves downstream. It is reduced to about 180,000 cfs about 1 mile

downstream and to about 171,000 cfs at lock and dam 1.

The increase in stage resulting from failure varies from approximately 2 feet near lower St. Anthony Falls to about 1 foot at lock and dam 1. Plate 11 presents the SPF with - and without - failure profiles from upper St. Anthony Falls (RM 853.8) to the mouth of the Minnesota River (RM 844.0). An attached set of inundation maps shows the SPF with dam failure outline for this reach and also upstream of St. Anthony Falls. Because of the generally steep river valley side slopes and the relatively minor stage increases for the with - failure condition, the without - failure outline could not be differentiated from the with - failure outline on these maps. Because the hydrographs have very little attenuation in the down stream routing reaches, additional hydrographs for these reaches are not included and the outflow hydrograph at the dam can be assumed to represent the hydrographs for these reaches. Discharges for the breach hydrograph can be interpolated from those displayed on Plate

Normal Pool Failure The normal pool failure hydrograph is shown on Plate 12. The peak flow immediately downstream of lower St. Anthony Falls increases from a base flow of 7,500 cfs to 43,000 cfs, but is quickly moderated as the flood wave travels downstream.

The stage increase is about 7.7 feet just below St. Anthony Falls, 3.0 feet at lock and dam 1, and 1.3 feet at the confluence with the Minnesota River. Plate 11 presents profiles for the normal pool and the normal pool breach.

9. INUNDATION MAPS

The areas inundated by the Standard Project Flood (SPF) with and without failure of the St. Anthony Falls dam are presented in Plates D-1 and D-2. Plate D-1 is an index map which shows the location of inundation map D-2. The inundation maps show one flood outline to represent both the with - and without - failure conditions since the difference in peak water surface elevation between the two cannot be differentiated at this map scale.

The peak flood time for the SPF without dam failure is the time interval measured from the moment at which the peak discharge occurs at the dam until the peak elevation occurs at a given location. For the SPF dam failure, the time interval is initiated from the beginning of dam failure. The peak flood times of the SPF are shown in Table D-1 on Plate D-1, located in Appendix D. With a flood as large as the SPF, flood damage may begin 5 to 6 days prior to the SPF peak.

10. AFFECTED AREAS

The areas inundated by the Standard Project Flood (SPF) with and without failure of the St. Anthony Falls dams are presented on Plate D-2. Failure of the upper and lower St. Anthony Falls dams during the SPF would not create a significant increase in damage or danger because the area flooded is well defined with little development and the increase in stage is minor. The magnitude of the SPF also makes it less likely that recreational or commercial

craft would be on the river if a dam breach occurred.

The normal pool failure would be dangerous to watercraft and persons on the shoreline immediately downstream of lower St. Anthony Falls. The flows would not be hazardous further downstream since the flow and stages would rise slowly and remain well below flood levels.

Locks and dams immediately downstream of the St. Anthony Falls project could become temporarily harder to control. Since the loss of the lower and upper dam would result in the loss of the navigation channel in the intermediate and upper pool, all surface vessels operating in these pools would be in some danger. Navigation attempting to move upstream of pool 1 would have to wait until repairs were made before they could proceed. Impacts on the non-Federal hydropower facilities at St. Anthony Falls for the events identified in this report would be the disruption of power generation capabilities. Rules and regulations governing these non-Federal interests are outlined in exhibit 1 of the Reservoir Regulation Manual.

11. IDENTIFICATION OF NEEDED EVACUATION PLANNING

a. Jurisdictions Affected

The project area affected in the maximum case of the Standard Project Flood with failure encompasses parts of the cities of Minneapolis and St. Paul in Hennepin and Ramsey Counties, Minnesota, respectively.

b. Evacuation Plans

Plans pertinent to the dissemination of flood warnings and evacuation in the portions of the jurisdictions which would be affected in the case of the Standard Project Flood with/without failure or a failure at normal pool should incorporate the information presented in this report into all existing and future plans. A copy of this report is to be provided to the appropriate emergency personnel for each of the affected communities.

c. Evaluation of Evacuation Plans

Principal characteristics of evacuation plans which affect their potential for successfulexecution are shown in Table 9.

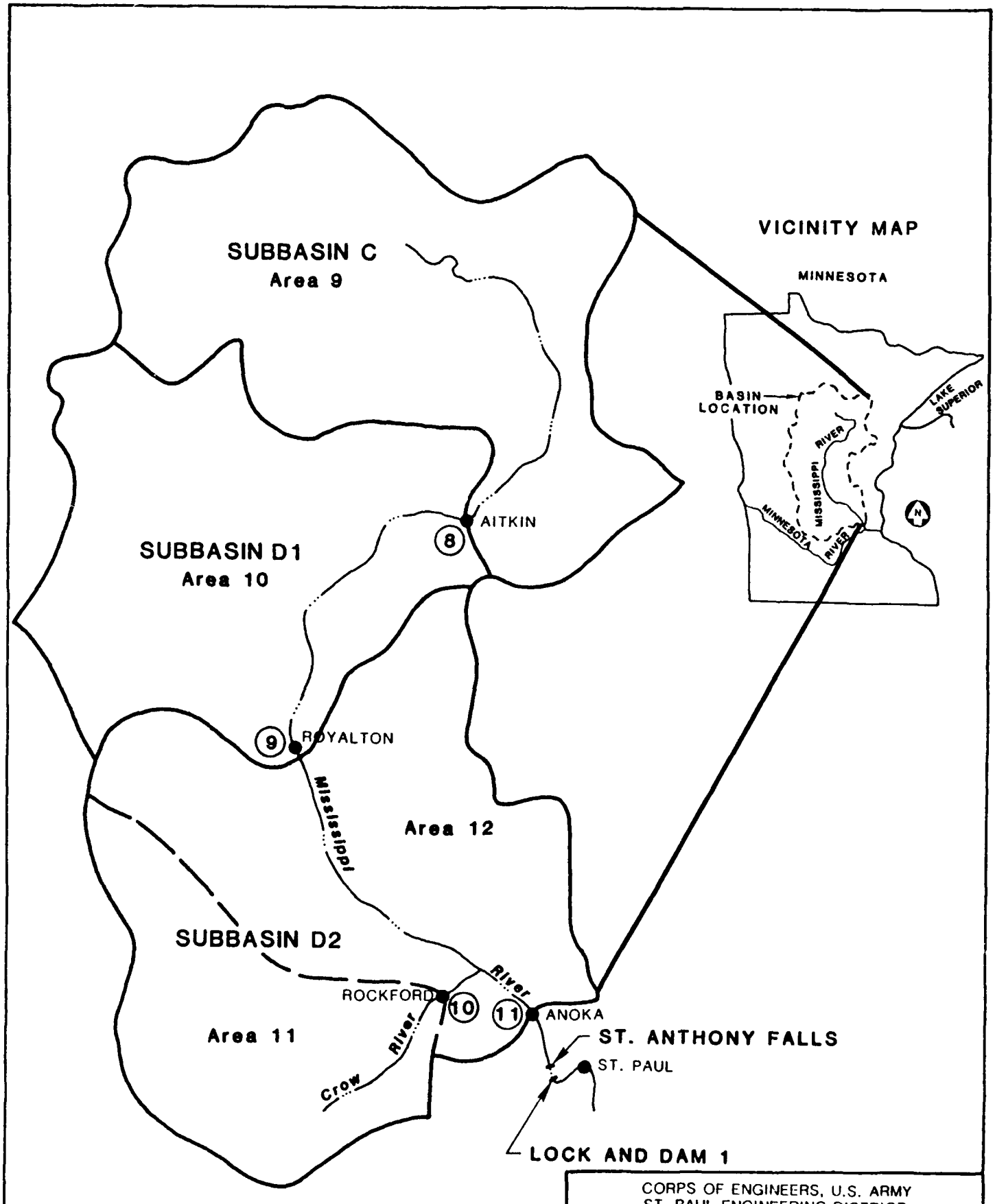
d. Evacuation Planning

Evacuation plans are to be developed through local coordination with the affected communities. Information on evacuation planning and examples of evacuation plans are available from the Corps of Engineers (see also Appendix D of this report).

TABLE 9

CHARACTERISTICS OF EVACUATION PLANS

Plan Characteristic	Plan 1	Plan 2
Is plan written?		
Is plan current?		
Does plan have formal legal status through appropriate adoption or recognition by non-federal authorities?		
Does plan specify actions to be taken in sufficient detail to avoid indecision on whether or not to execute the plan and how it should be executed?		
Does plan make specific assignments of responsibility for its initiation and execution?		
Does plan cover all parts of the jurisdiction requiring evacuation?		
Is successful execution of plan in potential emergency situations reasonable in view of the warning time likely to be available for an emergency?		
Is plan consistent with various causes of emergencies likely to exist at time evacuation is required?		
Does plan evidence realistic analysis of means of warning and transporting evacuees, lane capacities of escape routes and other pertinent matters?		
Are equipment, personnel and materials required for execution of the plan identified?		
Does plan contain adequate provisions for updating, testing, practice and other maintenance activities to assure its continued viability?		



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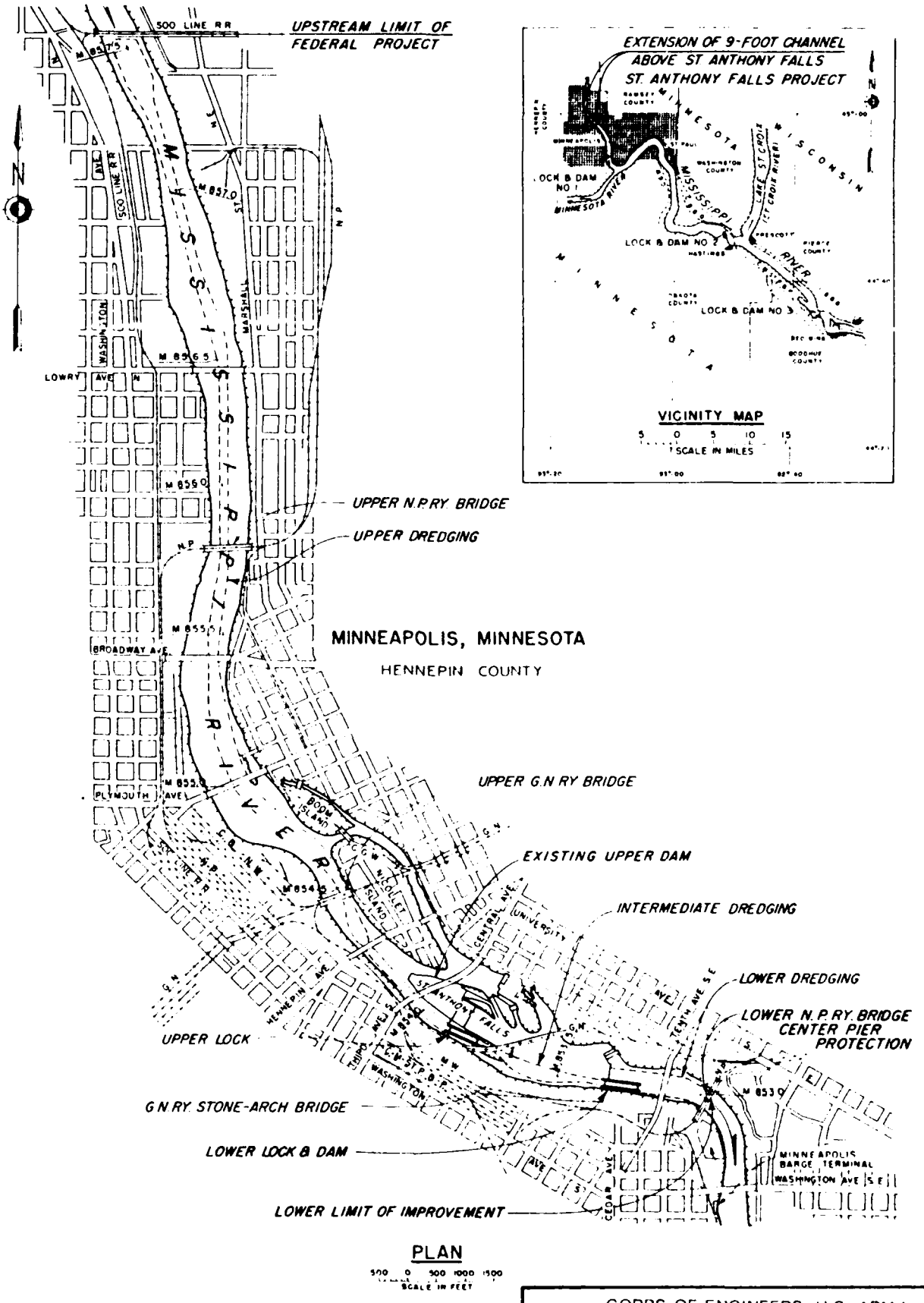
ST. ANTHONY FALLS EMERGENCY PLAN

BASIN SUB-AREAS

(UPPER MISSISSIPPI RIVER BASIN)

1987

PLATE-1



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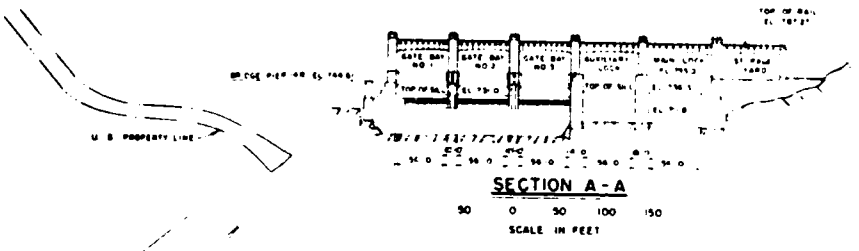
ST. ANTHONY FALLS EMERGENCY PLAN

SITE MAP

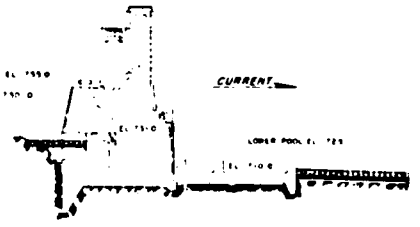
(UPPER MISSISSIPPI RIVER BASIN)
1987

PLATE-2



SECTION A-A

SCALE IN FEET

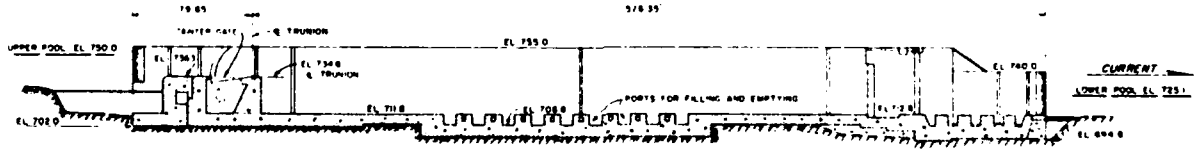


SECTION B-B

SCALE IN FEET

PLAN

SCALE IN FEET

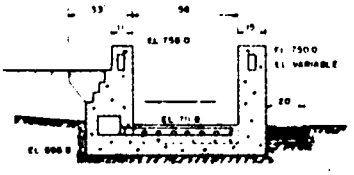


SECTION C-C

SCALE IN FEET

DEPTH ON UPPER GATE SILL	13 70	(U P EL 750 00)
DEPTH ON LOWER GATE SILL	12 30	(L P EL 725 10)
ELEVATION UPPER GATE SILL	736 30	
ELEVATION LOWER GATE SILL	712 80	

ELEVATIONS ARE REFERRED TO M S L (1912 ADJ)



SECTION D-D

SCALE IN FEET

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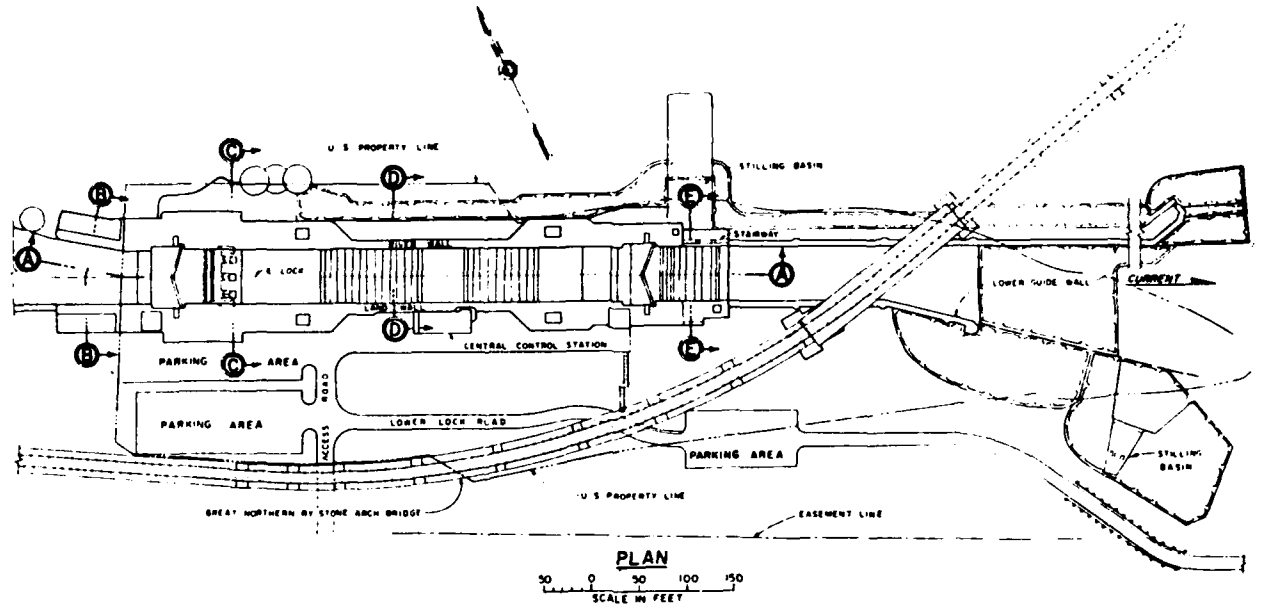
ST. ANTHONY FALLS EMERGENCY PLAN LOWER LOCK AND DAM

PLAN AND SECTIONS

(UPPER MISSISSIPPI RIVER BASIN)

1987

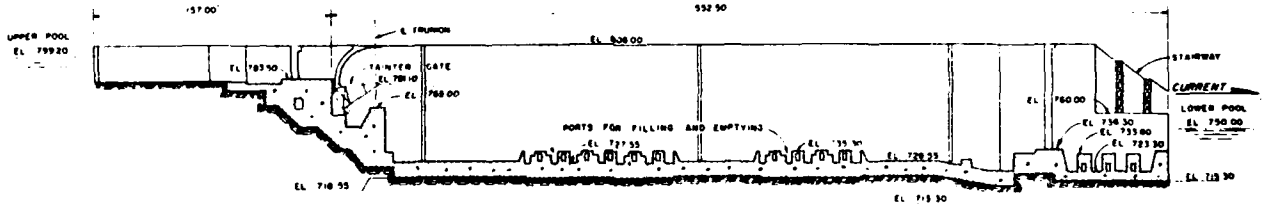
PLATE-3



PLAN

50 0 50 100 150

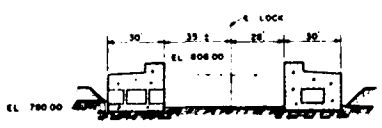
SCALE IN FEET



SECTION A-A

50' 25' 0 50' 100'

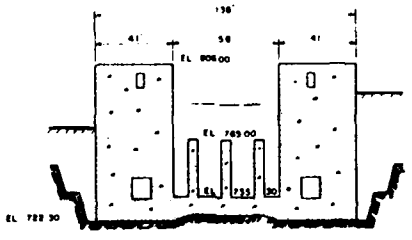
SCALE IN FEET



SECTION B-B

40' 20' 0 40' 80'

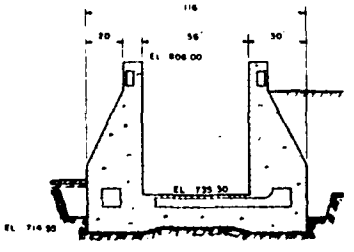
SCALE IN FEET



SECTION C-C

40' 20' 0 40' 80'

SCALE IN FEET



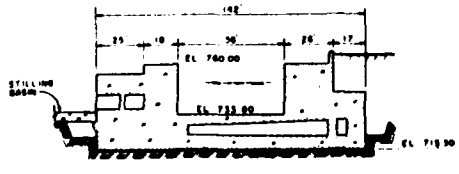
SECTION D-D

40' 20' 0 40' 80'

SCALE IN FEET

DEPTH ON UPPER GATE SILL 15 70 (U P EL 799 20)
DEPTH ON LOWER GATE SILL 13 70 (L P EL 750 00)
ELEVATION UPPER GATE SILL 783 50
ELEVATION LOWER GATE SILL 736 30

ELEVATIONS ARE REFERRED TO M S L (1912 ADJ.)



SECTION E-E

40 20' 0 40' 80'

SCALE IN FEET

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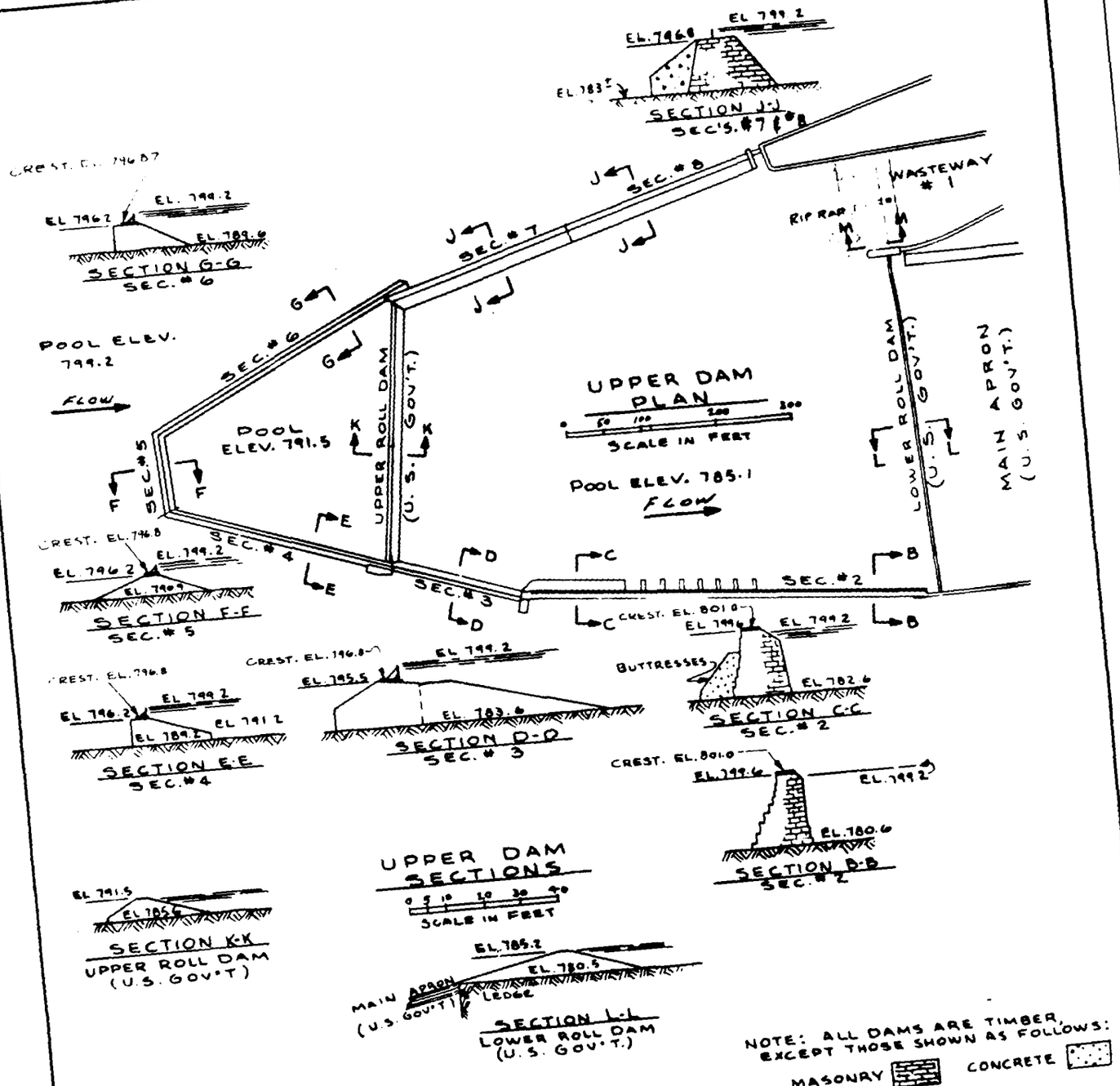
ST. ANTHONY FALLS EMERGENCY PLAN UPPER LOCK PLAN AND SECTIONS

(UPPER MISSISSIPPI RIVER BASIN)

1987



NOTE: THIS IS A PORTION OF NORTHERN STATES POWER COMPANY
DWG NO. NF 21894-B

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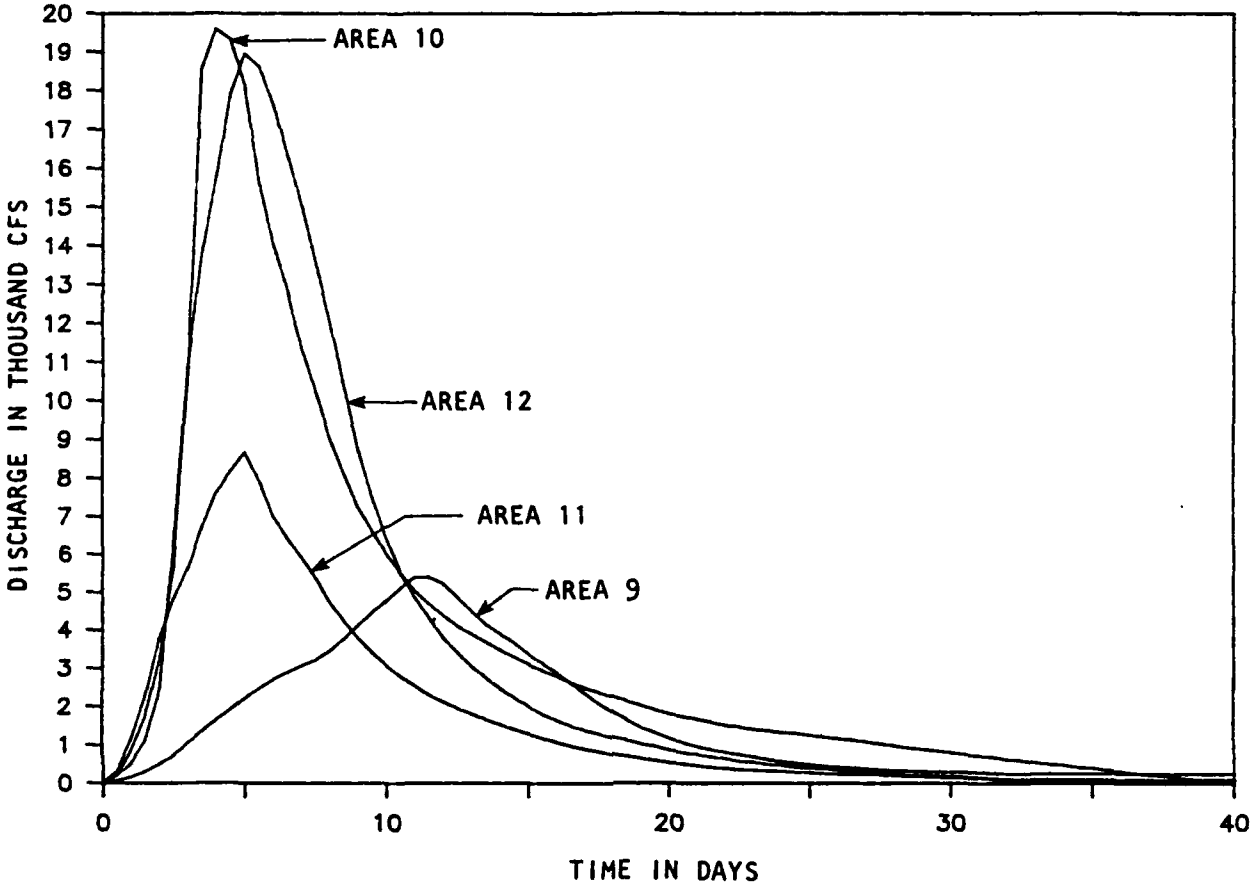
ST. ANTHONY FALLS EMERGENCY PLAN UPPER DAM PLAN AND SECTIONS

(UPPER MISSISSIPPI RIVER BASIN)
1987

PLATE-5



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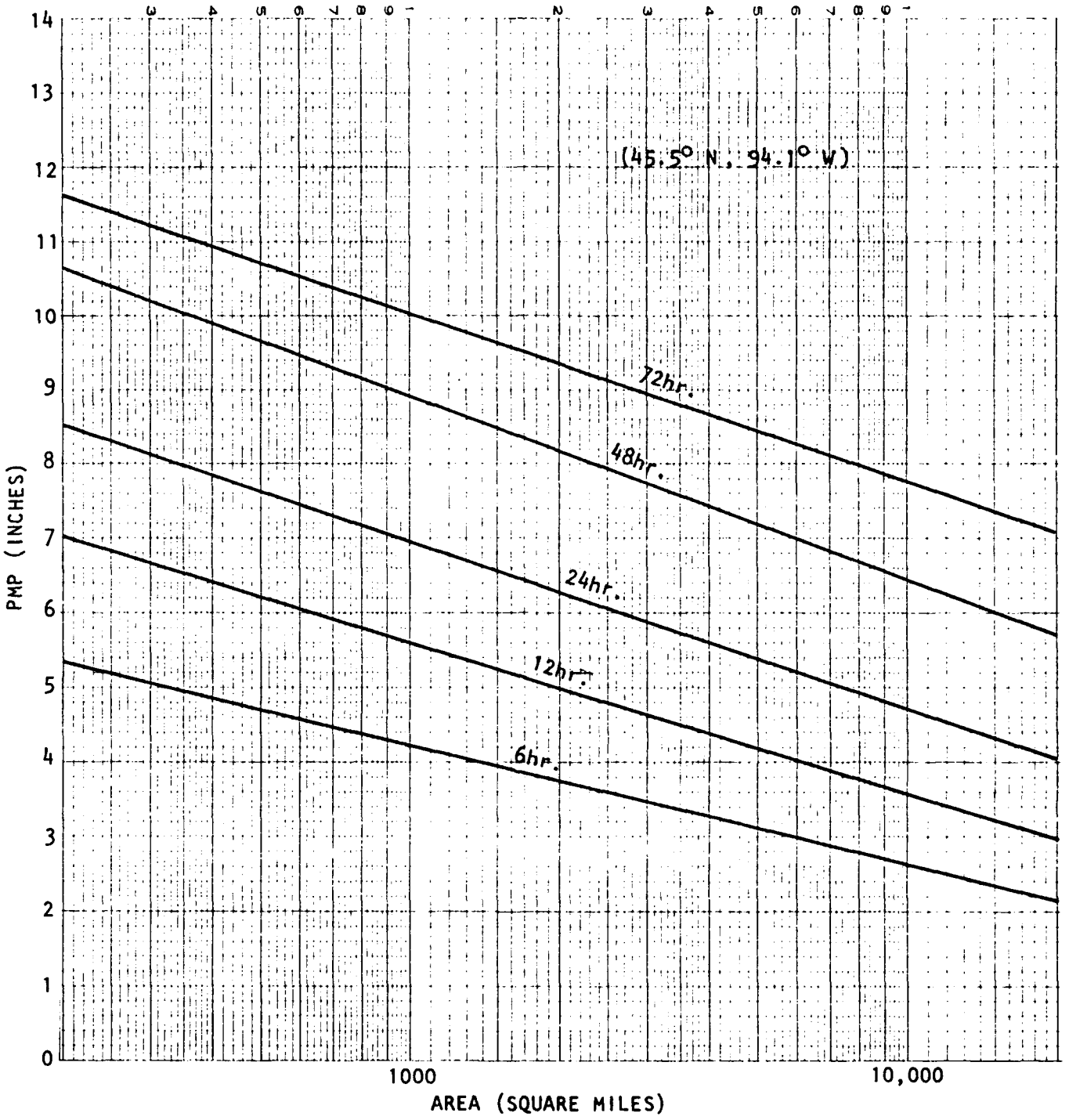
ST. ANTHONY FALLS EMERGENCY PLAN

PEAKED UNIT HYDROGRAPHS

(UPPER MISSISSIPPI RIVER BASIN)

1987

PLATE-6



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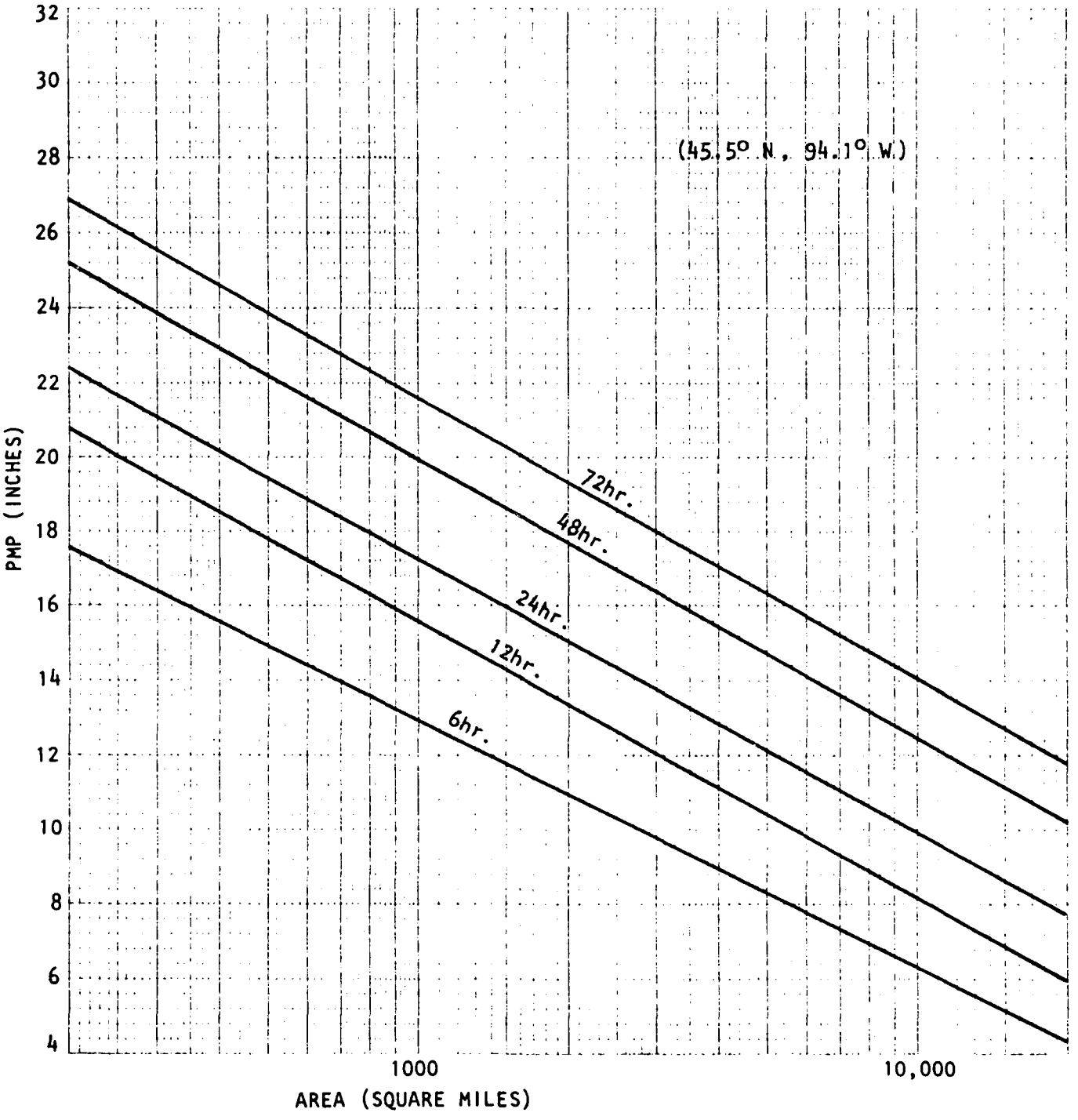
ST. ANTHONY FALLS EMERGENCY PLAN

MARCH 15 PMP

(UPPER MISSISSIPPI RIVER BASIN)

1987

PLATE-7



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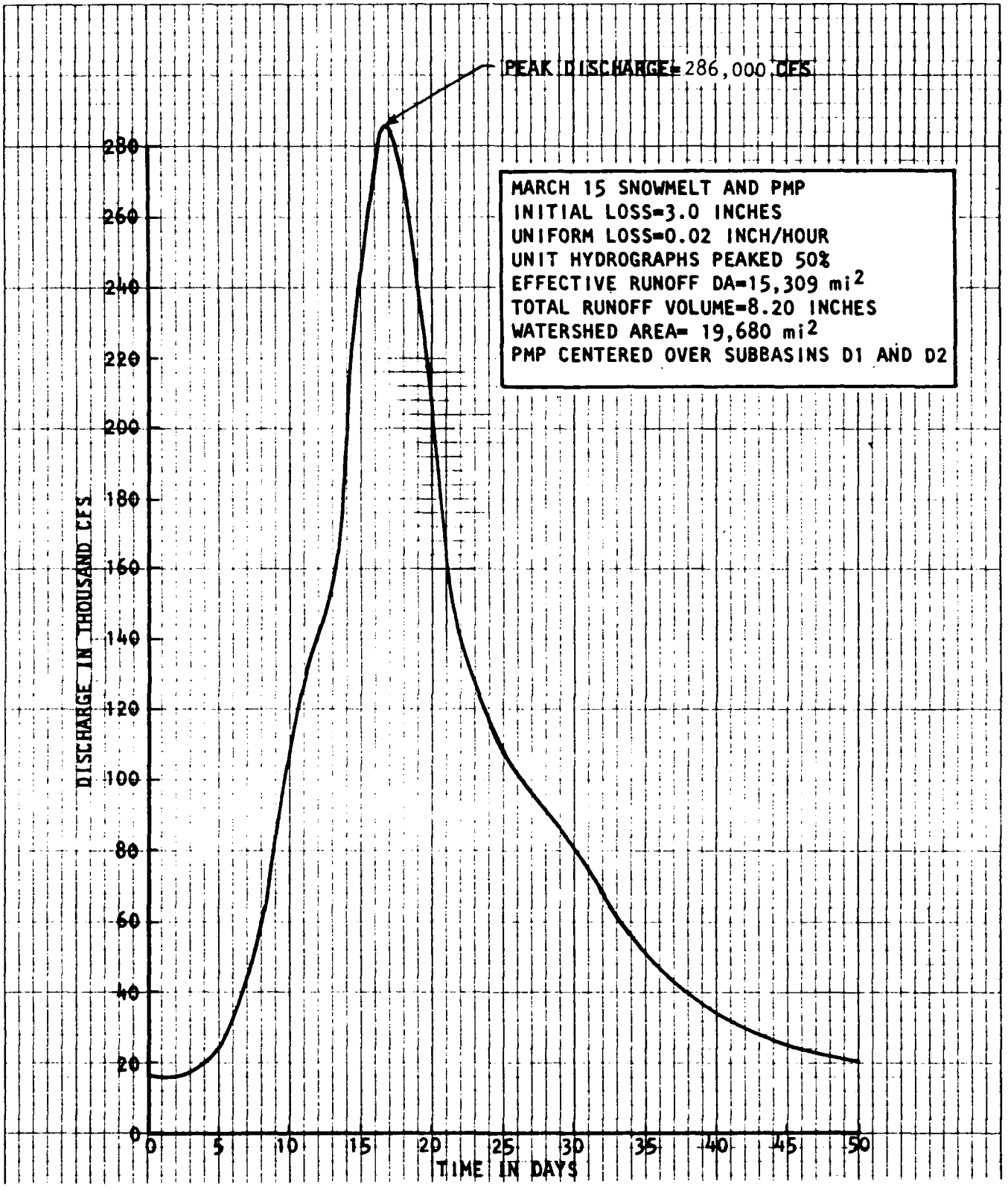
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS EMERGENCY PLAN

ALL SEASON PMP

(UPPER MISSISSIPPI RIVER BASIN)
1987

PLATE-8



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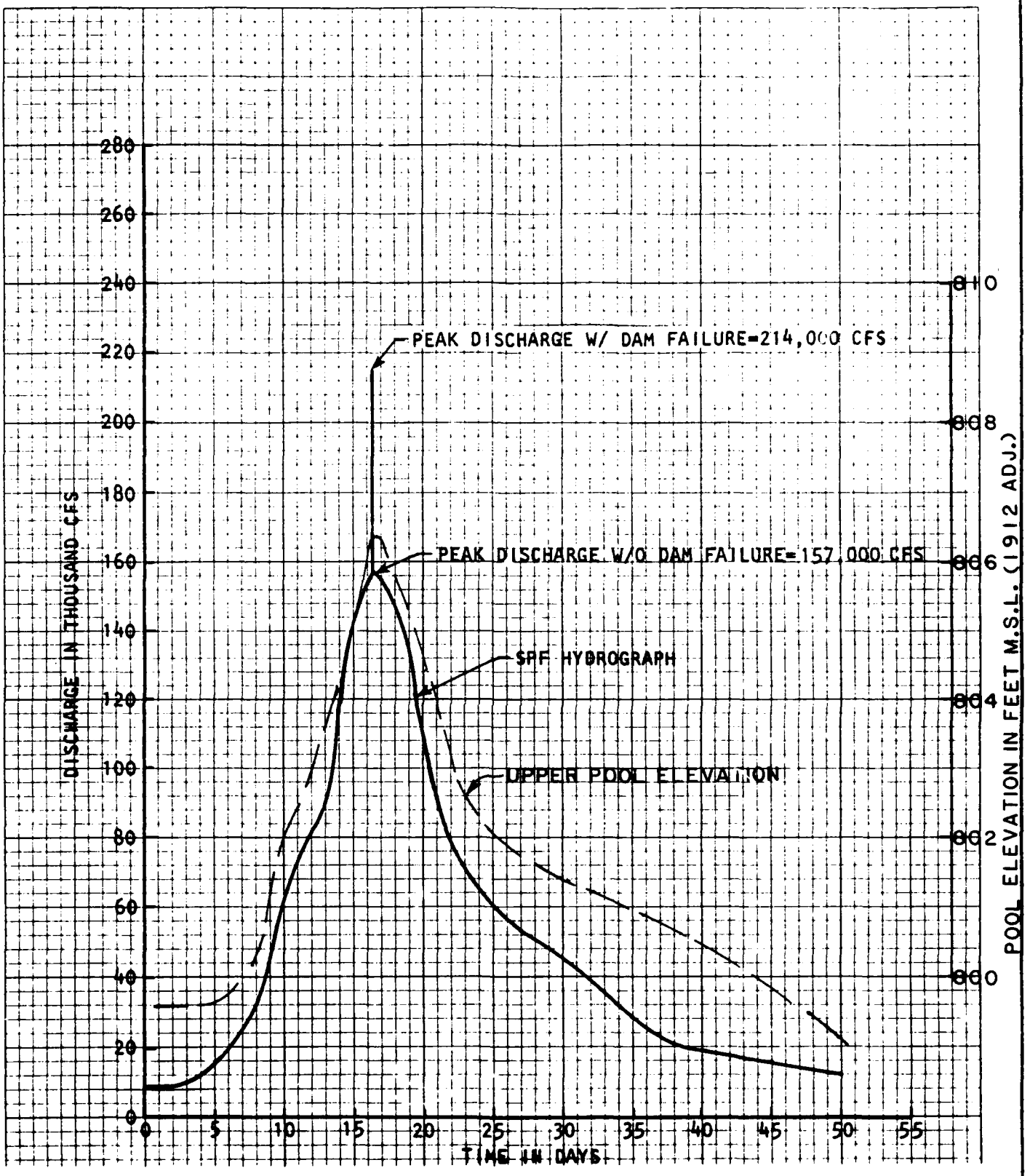
ST. ANTHONY FALLS EMERGENCY PLAN

PMF AT MINNEAPOLIS

(UPPER MISSISSIPPI RIVER BASIN)
1987



NOTE: The SPF inflow hydrograph is the same as the SPF outflow hydrograph without breach, due to the small amount of storage above the dam.

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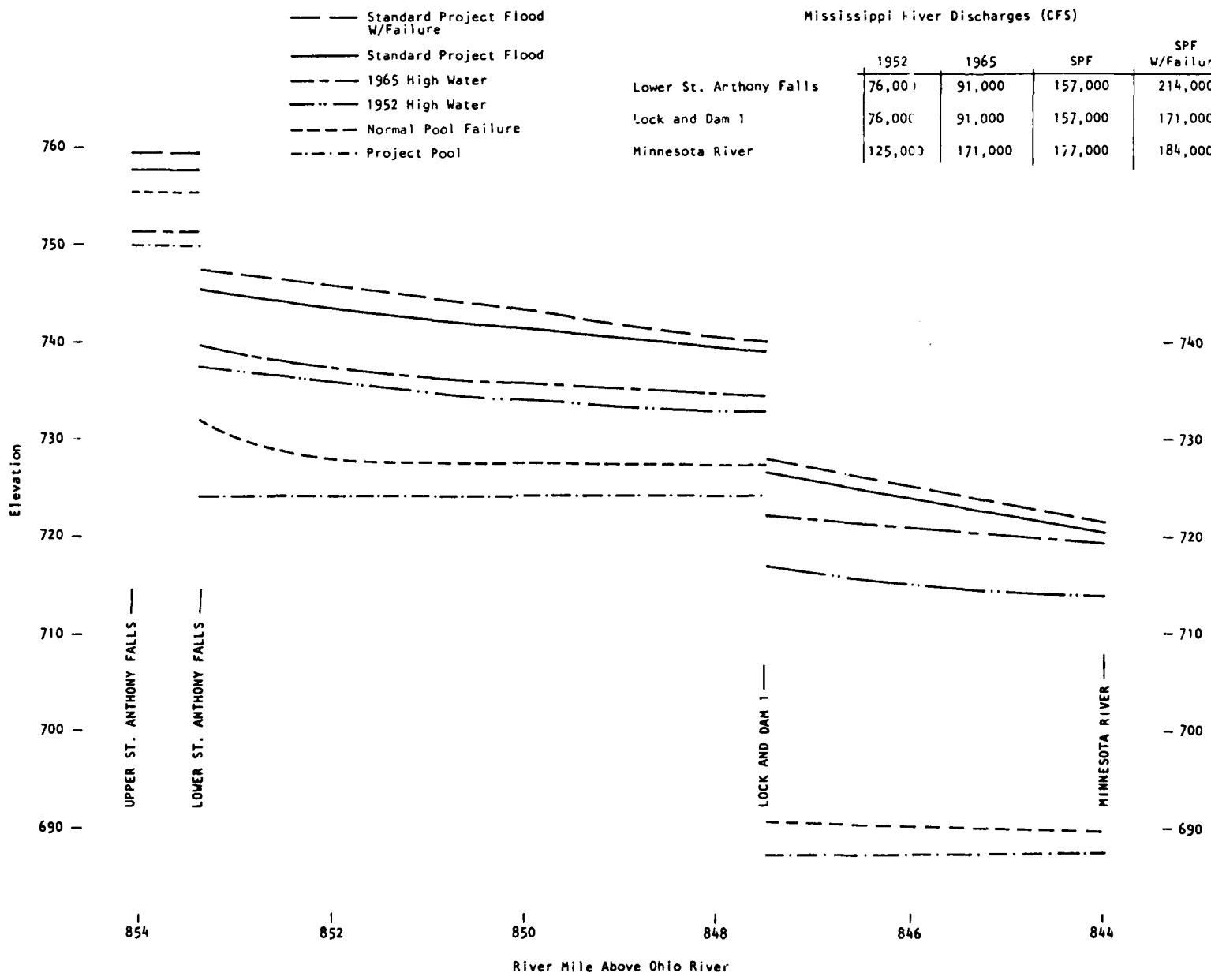
ST. ANTHONY FALLS EMERGENCY PLAN
SPF OUTFLOW WITH AND WITHOUT FAILURE
(UPPER MISSISSIPPI RIVER BASIN)
1987

PLATE-10



Mississippi River Discharges (CFS)

	1952	1965	SPF	SPF W/Failure
Lower St. Anthony Falls	76,000	91,000	157,000	214,000
Lock and Dam 1	76,000	91,000	157,000	171,000
Minnesota River	125,000	171,000	177,000	184,000

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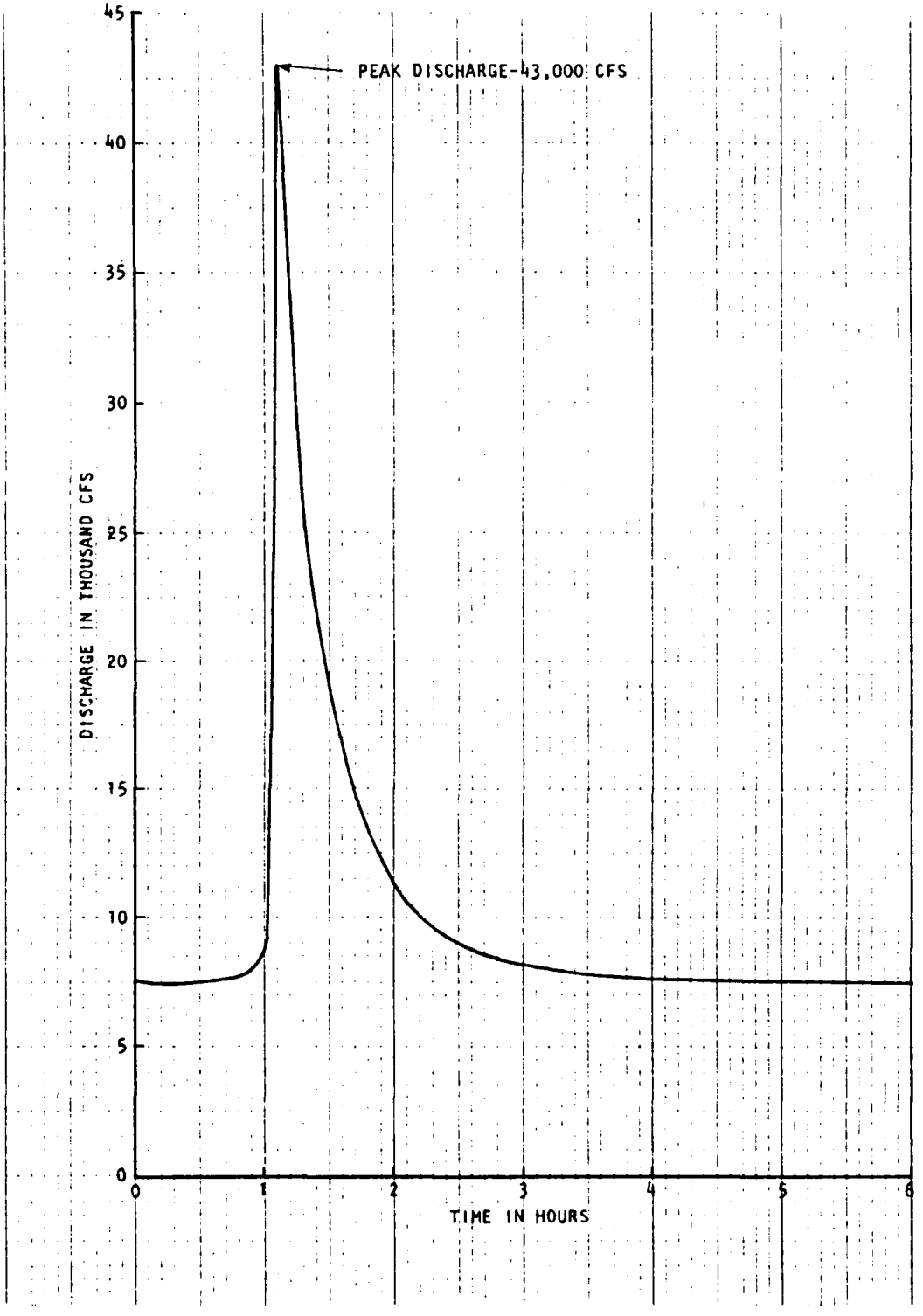
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS
EMERGENCY PLAN
MISSISSIPPI RIVER
FLOOD PROFILES

RIVER MILES 844.0 TO 854.1
(UPPER MISSISSIPPI RIVER BASIN)

1987

PLATE-11



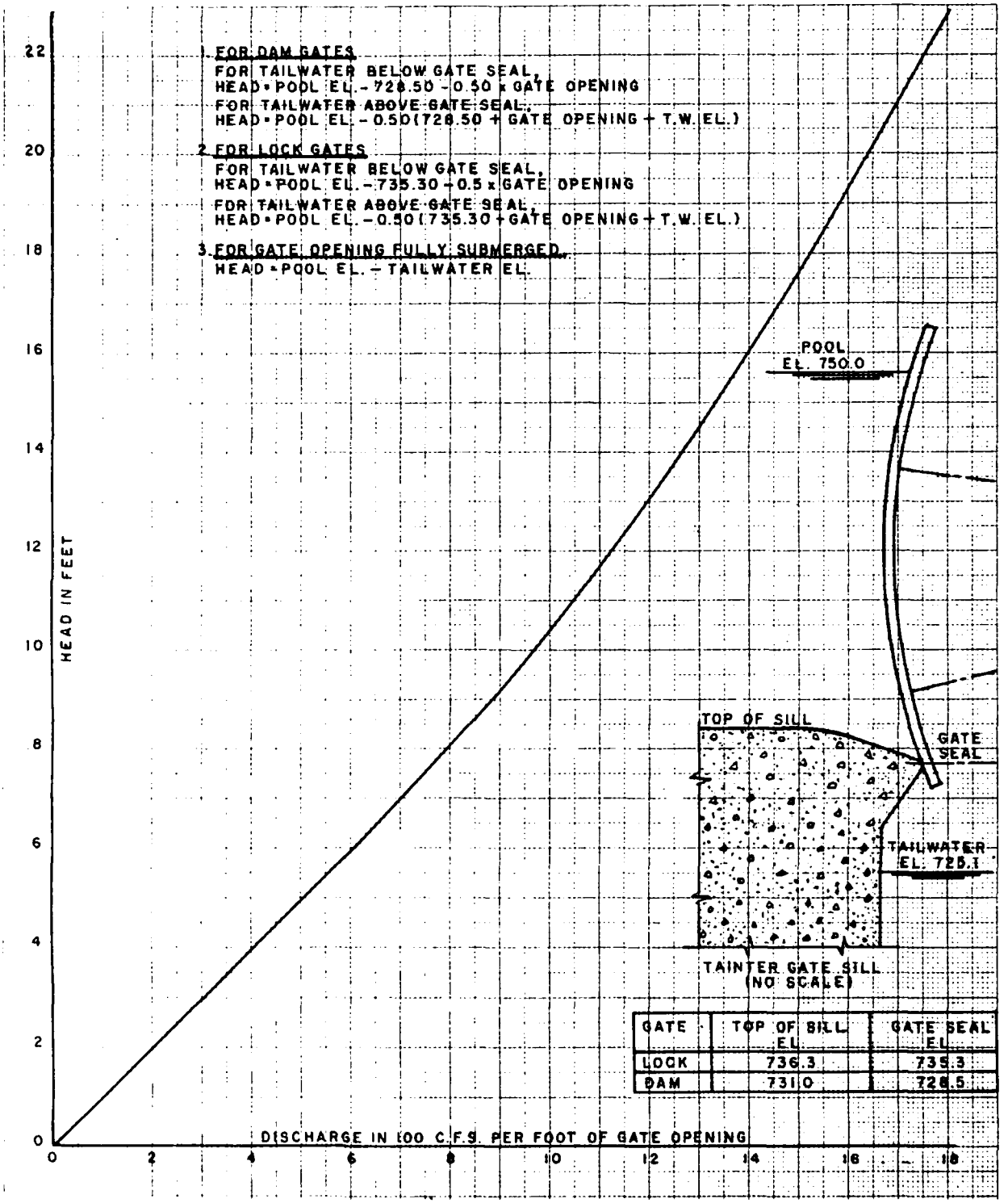
CORPS OF ENGINEERS, U.S. ARMY
ST. PAUL ENGINEERING DISTRICT
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS EMERGENCY PLAN NORMAL POOL BREACH HYDROGRAPH

(UPPER MISSISSIPPI RIVER BASIN)

1987

PLATE-12



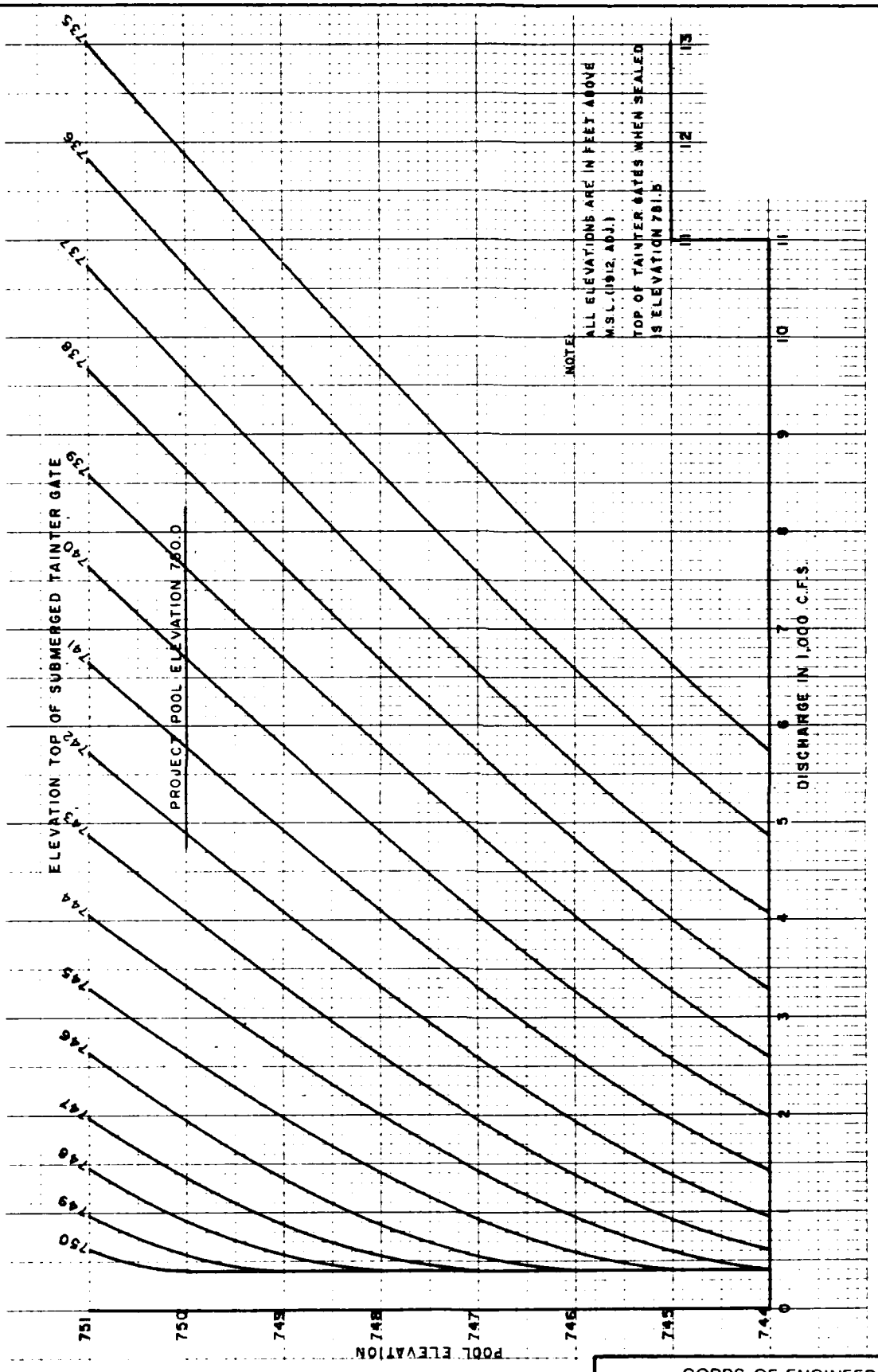
GATE	TOP OF SILL EL	GATE SEAL EL
LOCK	736.3	735.3
DAM	731.0	728.5

CORPS OF ENGINEERS, U.S. ARMY
ST. PAUL ENGINEERING DISTRICT
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS EMERGENCY PLAN
LOWER LOCK AND DAM TAINTER GATE DISCHARGE RATING CURVE

(UPPER MISSISSIPPI RIVER BASIN)
1987

PLATE-13



CORPS OF ENGINEERS, U.S. ARMY
ST. PAUL ENGINEERING DISTRICT
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS
EMERGENCY PLAN
LOWER LOCK AND DAM DISCHARGE
OVER ONE SUBMERGED TAINTER GATE
(UPPER MISSISSIPPI RIVER BASIN)
1987

EMERGENCY IDENTIFICATION SUBPLAN

APPENDIX A

TO

EMERGENCY PLAN

FOR

THE LOCKS AND DAMS AT ST. ANTHONY FALLS

MINNEAPOLIS, MINNESOTA

March, 1987

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EMERGENCY IDENTIFICATION SUBPLAN
FOR THE LOCKS AND DAMS AT ST. ANTHONY FALLS
MINNEAPOLIS, MINNESOTA

A-1. Introduction

Conditions affecting operation of the St. Anthony Falls locks and dam could result in a hazard to life and/or property due to high headwater levels and/or sudden release of large volumes of water. Early identification of the existence or potential for occurrence of such conditions is essential as a basis for initiating emergency operations and/or repairs and for issuing appropriate notifications to higher authority and potentially affected parties.

a. Purpose

This subplan implements a portion of the Corps' program to prepare emergency plans for all Corps dams. It establishes procedures for identifying impending and existing emergencies affecting the operation and safety of the St. Anthony Falls locks and dam.

b. Scope

This subplan deals with identification of impending or existing emergencies related to excess seepage, foundation failure, extreme storm, structural damage or failure due to scour. Instructions are included concerning:

(1) Monitoring and report of conditions.

(a) Routine - during duty hours. Monday through Friday (0730-1600).

(b) Non-routine - on a 24-hour basis or as directed by District Office. Additional personnel may be required at discretion of the Area Lockmaster.

(2) Communications between the project office, St. Paul District Office, and Area Lockmaster's Office.

(3) Criteria for action including declaration of pre-emergency or emergency condition and activations of the Notification Subplan and/or Emergency Operations and Repair Subplan.

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with operation of the St. Anthony Falls locks and dam.

A-2. Definitions

a. Pre-Emergency

A "Pre-emergency" condition is one in which some impending or existing threat to the safe operation of the dam or headwater is identified but no significant hazard to life or property is expected to occur. Declaration of a pre-emergency conditions is internal to the Corps of Engineers and does not require notification of other parties or warnings to evacuate.

b. Emergency

An "Emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an emergency condition may be imminent or longer term. Declaration of an emergency condition requires notification to others and issuance of warnings to evacuate potentially hazardous areas.

c. Lockmaster

The term "Lockmaster" means the dam tender or the individual in charge of the St. Anthony Falls locks and dam.

d. Area Lockmaster

The term "Area Lockmaster" means the person in charge of the Area Lockmaster's Office.

e. District

The term "District" means one of the following elements depending upon which is appropriate for the situation at hand.

(1) Dam Safety Officer. The Dam Safety Officer must be kept informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required for the pre-emergency or emergency situation. Also responsible for keeping the Dam Safety Committee, and the NCD Dam Safety Officer informed of the pre-emergency or emergency situation.

(2) Project Operations Branch. Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Responsible for keeping the Dam Safety Officer informed of the pre-emergency or emergency situation. Also, responsible for matters involving normal dam operations, and/or other matters not covered by the other District elements.

(3) Emergency Operations Center. Provides a 24-hour telephone contact with District Office. Responsible for keeping the

Dam Safety Officer, the Commander/District Engineer, and the NCD Emergency Manager informed of the pre-emergency or emergency situation. Also responsible for matters involving national security, disasters, and mobilization.

(4) Water Control Center. Part of Hydrology Section in Geotechnical, Hydraulics, and Hydrologic Engineering Branch. Responsible for matters involving reservoir regulation.

(5) Geotechnical Design Section. A section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving the foundation stability of the dam.

(6) Design Branch. Responsible for matters involving the structural integrity of the locks and dams.

(7) Project Management Branch. Responsible for management support.

(8) Planning Division. Responsible for management support, and matters involving environmental analysis and cultural resources.

A-3. Responsibility for Conduct

a. Lockmaster

(1) Carrying out routine surveillance (paragraph A-4a).

(2) Carrying out non-routine observations and measurements as directed by the District (paragraph A-4b).

(3) Advising District of potentially hazardous situations (paragraph A-4c).

(4) Maintaining proper records of communications (paragraph A-5).

(5) Acting independently, when required by disruption of communications or the urgency of the circumstances, to declare a pre-emergency or emergency condition (paragraph A-8) and to activate the Notification Subplan and/or Emergency Operations and Repair Subplan as appropriate.

b. Area Lockmaster

(1) Provide direction and supervision to the Lockmaster in coordination with the District Office.

(2) Providing assistance to District as requested.

(3) Assuming responsibilities of District in event of disruption of communications between the project area and the District Office.

c. District

(1) Carrying out routine monitoring of conditions potentially affecting regulation (paragraph A-6a) and alerting the Area Lockmaster and Lockmaster of situations requiring increased readiness and/or 24-hour supervision.

(2) Providing guidance to the Area Lockmaster and Lockmaster on all potentially hazardous situations which arise and directing any non-routine observations and measurements needed to assist in identification, confirmation or analysis of existing or impending threats to safe operation of the dam (paragraph A-6b).

(3) Providing personnel for on-site evaluation of potentially hazardous conditions relating to structures, geology, soils and other aspects requiring expert analysis.

(4) Declaring the existence of pre-emergency and emergency conditions and directing activation of the Notification Subplan and/or Emergency Operations and Repair Subplan.

(5) Maintenance of the subplan (paragraph A-9).

A-4. Observations, Tests, and Reports by Lockmaster

a. Routine Observations and Tests (all entered in daily log).

(1) Daily.

(a) Local 24-hour precipitation, and 8 a.m. temperature.

(b) Pool and tailwater elevations for the upper and lower locks every four hours (tailwater of upper lock = headwater for lower lock).

(c) 24-hour average discharge through the lower dam power plant obtained from Northern States Power Company.

(d) Seasonal

(1) Navigation Season - Daily Commercial, River Traffic Count

(2) Winter Conditions - Biweekly Ice Conditions

(2) Monthly.

(a) Visual inspection for excess seepage or structural damage.

(b) Visual inspection for excessive scour downstream of dam.

(3) At request of District.

(a) Snow cover, water content (seasonal).

(b) Test radio, and other communications equipment.

b. Non-routine Observations and Tests

(1) Perform snow surveys as requested (seasonal).

(2) Monitor precipitation gages on hourly basis when significant rains are occurring as directed by District Office.

(3) Perform other observations and tests as directed by District; such as seepage and cracking in the galleries.

c. Reports

(1) To the Chief, Water Control Center

(a) Reports precipitation of 1.5 inches or more in 24-hours or less in the vicinity of the dam.

(b) Pool elevation above normal seasonal.

(c) Reports severe ice conditions or temporary constrictions downstream of dam.

(2) To the Chief, Geotechnical Design Section

(a) Any conditions indicating instability of the foundation of the structure, such as excessive under seepage.

(b) Indications of unusual scour.

A-5. Records

The Lockmaster logs all telephone, radio or other communications received from or sent to District. This log is a bound ledger or notebook used only as an official diary. Each communication includes:

a. Date
b. Time
c. Person called or calling
d. Information transmitted/instructions received
e. Action requested by the District
f. Action taken in response to request

g. Result of action
h. Remarks
i. Name of operator issuing information/orders
j. Initials of person receiving communications

A-6. Observations, Tests and Alerts by District

a. Daily Routine Observations and Tests

(1) Check weather forecasts for areas affecting runoff.

(2) Check concurrence of pool level readings from staff gage and recording gage.

b. Non-routine Observations and Tests

Specify additional observations and tests by the Lockmaster and make additional observations and tests as necessary to:

(1) Assure proper functioning of all instrumentation.

(2) Assist in identification, confirmation or analysis of existing or impending threats to safe operation of the dam.

c. Alerts

Provide alerts to Lockmaster and appropriate District personnel when:

(1) Weather, ice or other conditions require increased readiness, and surveillance or the possible need for activation of the Emergency Operating Center.

(2) Consideration is being given to declaration of a pre-emergency or emergency condition.

A-7. Communications

a. Normal

Communications between the District and Lockmaster will normally be by radio. Radios at the Electronic Service Center and District's Emergency Operating Center will be manned on a 24-hour basis during all flood emergencies and whenever a pre-emergency or emergency condition is in effect. Radio frequencies and call letters for pertinent parties are listed in Table A-1. (See Annex C to ER 500-1-1, Reference 21, and NCS Plan 500-1-2).

b. Back-Up

The telephone communications network between the District Office and Area Lockmaster Office will be used to back-up radio

communications. Office and home phone numbers of key District and Area Lockmaster Office personnel are listed in Table A-1.

c. Emergency

During a situation when both radio and telephone communications between the District Office and project area are disrupted, others equipped with radio or telephone facilities will be called on for assistance. Those to whom applications for assistance may be made are listed in Table A-1 along with information for telephone and radio contacts.

A-8. Declaration of Pre-emergency and Emergency Conditions

a. Responsibility

The District is responsible for the declaration of "Pre-emergency" or "Emergency" conditions in all but extreme cases where the loss of communications or the speed of onset of a situation prevents the Lockmaster from conferring with the District.

Pre-emergency and emergency declarations will be made by the Commander/District Engineer. The Dam Safety Committee will provide recommendations to the District Engineer.

b. Conditions Warranting Declaration

Not every situation requiring declaration of a pre-emergency or an emergency condition can be specified. Initiative must be exercised by all involved personnel and each situation judged individually on the basis of all relevant factors.

(1) Pre-emergency

Examples of circumstances warranting declaration of a pre-emergency condition include:

(a) Spring runoff is always handled as a pre-emergency condition. During the remainder of the year, the National Weather Service flood stage at the locks or more shall be the warranting factor.

(b) Evidence of excessive scour downstream of spillway such as irregular flow conditions.

(c) Any visual onset of structural damage to the locks and dams such as changes in the horizontal or vertical crest alignment, or evidence of cracks in the spillway.

(d) Evidence of excessive seepage or additional cracking by visual inspection of the dams.

(e) Threats of sabotage or occurrence of sabotage of non-critical project features.

(2) Emergency

Examples of conditions warranting declaration of an emergency condition include:

(a) Stage at the lock and dam is at or over the National Weather Service flood stage and is increasing.

(b) Major scour problems downstream of the dam causing erosion of the foundation.

(c) Major structural damage, breaks in the dam, progressive changes in the horizontal or vertical crest alignment.

(d) Threats of sabotage or occurrence of sabotage to critical project features.

c. Action Upon Declaration

(1) Lockmaster

(a) Staff telephones as directed by District office.

(b) Activate appropriate portions of Notification Subplan and Emergency Operations and Repair Subplan.

(c) Maintain monitoring/surveillance of situation responsible for declaration.

(d) Perform non-routine observations and tasks as directed by District.

(e) Test radio communication.

(f) Request assistance needed from District to perform (a) through (e) above.

(2) Area Lockmaster

(a) Monitor telephones on 24-hour basis.

(b) Place all personnel on standby for emergency duty if directed by District office.

(c) Test radio communications.

(3) District

(a) Activate Emergency Operation Center.

(b) Staff selected telephones on a 24-hour basis.

(c) Test radio communications.

(d) Place key staff on standby for emergency duty.

(e) Provide detailed instructions to Lockmaster for any needed evaluation of situation.

(f) Dispatch personnel to dam site as required to provide expert evaluation of situation and to assist Lockmaster as needed.

(g) Activate appropriate portions of Notifications Subplan and Emergency Operations and Repair Subplan.

A-9. Subplan Maintenance

a. Updating

This subplan shall be updated as needed by the Dam Safety Officer, including:

(1) Annually.

(2) Whenever needed by modifications in instrumentation at or affecting the project, dam operating procedures, overall District emergency procedures, and/or changes of personnel.

b. Testing

The Chief, Project Operations Branch, shall annually direct a thorough inspection of all mechanical, electrical and other equipment pertinent to conduct of this subplan. The inspection shall include all tests, servicing and calibration necessary to ensure proper functioning.

c. Familiarization

The Dam Safety Officer shall ensure all pertinent Corps personnel are aware of and familiar with this subplan including:

(1) Circulation of each updated version for review and signature by pertinent District staff, Area Lockmaster and the Lockmaster.

(2) Annual review session with staff of the Water Control Center and Lockmaster.

(3) Briefing, within two weeks of assuming duties, of all new Water Control Center staff.

(4) Briefing, before assumption of duties, of any new Lockmaster.

TABLE A-1
Information on Key Contacts

PARTY	TELEPHONE NUMBER OFFICE	TELEPHONE NUMBER RESIDENCE	RADIO FREQUENCY	RADIO CALL LETTERS
DISTRICT PERSONNEL				
Lockmaster, Robert Stahl (Upper Lock)	(612)333-5336	(612)757-2299	FM SSB	WUD611
Lockmaster, Robert Stahl (Lower Lock	(612)332-3660	(612)757-2299	FM SSB	WUD614
Assistant Lockmaster, Joseph Dvorak	(612)332-3660	(612)432-6116	FM SSB	WUD614
Area Lockmaster, Arden Duval	(612)455-3194	(612)731-9650	FM	WUD-62

St. Paul District Office

Emergency Operations Center[1]
Twenty-four (24) hour telephone service. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving national security, disasters, mobilization or NWS flood forecasts. Center will contact Dam Safety Officer, the Commander/District Engineer and NCD.

District Emergency Operations Center	(612)220-0208	Contact Hastings Electronic Service
David Christenson, Chief, Emergency Management	(612)220-0204 (612)690-5749	(612)437-2210(call letters - WUD6)
Natural Disaster Planner	(612)220-0204	

Project Operations Branch
Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving normal dam operations, and/or matters not covered by other District elements. Project Operations Branch will contact Dam Safety Officer for engineering and technical assistance and keep him informed of situation.

SSB(Primary 5040Khz)
1st Alternate-6020Khz LSB)
(Emergency-5015Khz LSB)

Dennis Erickson Chief, Natural Resource Management Section	(612)220-0325	(612)452-6850
Thomas Oksness, Chief, Lock and Dam Section	(612)220-0322	(612)439-0272
Dennis Cin, Chief, Project Operations Branch	(612)220-0320	(612)455-6786

Dam Safety Officer
To be informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the pre-emergency or emergency situation.

Robert Post, Chief, Engineering Division	(612)220-0303	(612)437-1316

TABLE A-1
Information on Key Contacts (continued)

PARTY	TELEPHONE NUMBER OFFICE	RESIDENCE	RADIO CALL LETTERS
Water Contol Center[3]			
For matters involving reservoir regulation.			
Edward Eaton, Water Control Center[1]	(612)220-0617	(612)731-9426	WUD613
Bonnie Montgomery, Water Control Center[1]	(612)220-0618	(612)450-0909	WUD613
Gordon Heitzman, Water Control Center[1]	(612)220-0620	(612)429-9500	
Kelsey Willis, Water Control Center[1]	(612)220-0619	(612)566-5022	
Helmer Johnson, Chief, Geotechnical,[1] Hydraulics & Hydrologic Engineering Branch	(612)220-0602	(612)633-7791	
Geotechnical Design Section[3]			
For matter involving the structural integrity of the dam			
W. Grant Westall, Geotechnical Design Section	(612)220-0644	(612)455-7632	
Helmer Johnson, Chief, Geotechnical Hydraulics & Hydrologic Engineering Branch	(612)220-0602	(612)633-7791	
Design Branch[3]			
For matters involving the structural integrity of the outlet structures.			
Marlin Munter, Chief, Design Engr. Section[1]	(612)220-0511	(612)784-6123	
Charles Spitzack, Chief, General Engr. Section[1]	(612)220-0512	(612)645-7301	
Robert Fletcher, Chief, Design Branch[1]	(612)220-0510	(612)484-4998	
Others[3]			
If none of the above can be reached.			
Dale Mazar, Chief, Project Management Br.[2]	(612)220-0444	(612)631-1940	
Wayne Knott, Chief, Environmental Resources Br.[2]	(612)220-0400	(612)739-2724	
Louis Kowalski, Chief, Planning Division[2]	(612)220-0307	(612)457-6453	
Ltc. David Nelson, Deputy Commander[2]	(612)220-0301	(715)247-5661	
Col. Joseph Briggs, District Commander[2]	(612)220-0300	(612)894-7142	
External Contacts			
Hennepin County, Minnesota Emergency Preparedness Division (Civil Defense)		(612)827-5687	
Ramsey County, Minnesota Emergency Preparedness Division (Civil Defense)		(612)228-6261	
Dakota County, Minnesota (Civil Defense)		(612)437-0414	
MN State Patrol[4]			
East Metro		(612)452-3246	
West Metro		(612)541-9411	
Cities of Minneapolis and St. Paul Metro Area Emergency - Police, Sheriff Ambulence and Fire		911	

University of Minnesota	
Police	(612)624-3550 (24 hours)
Office of Emergency Management	(612)625-2802 or 625-3511
Northern States Power Company	
System Control Center	(612)330-6210 (24 hours)
Hennepin Island Power Plant	(612)330-6166
Lower Dam Power Plant	(612)330-6093
St.Anthony Falls Hydro Proj. Superintendent	(612)330-5847

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1 Call personnel in order listed until contact is made.
2 To be called in the order listed.
3 To be contacted if no contact can be made with other elements.
4 Potential Sources of Assistance in Communication.

EMERGENCY OPERATIONS AND REPAIR SUBPLAN

APPENDIX B

TO

EMERGENCY PLAN

FOR

THE LOCKS AND DAMS AT ST. ANTHONY FALLS

MINNEAPOLIS, MINNESOTA

March, 1987

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EMERGENCY OPERATIONS AND REPAIR SUBPLAN
FOR THE LOCKS AND DAMS AT ST. ANTHONY FALLS
MINNEAPOLIS, MINNESOTA

B-1 Introduction

Conditions affecting operation of the St. Anthony Falls locks and dam could result in a hazard to life and/or property due to high headwater levels and/or sudden release of large volumes of water. Prompt conduct of emergency operations and repairs is essential for minimizing hazards to life and property.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for emergency operations and repairs to deal with impending and existing emergencies affecting the operation and safety of the St. Anthony Falls locks and dam.

b. Scope

This subplan describes emergency operations and repairs to be implemented upon declaration of a pre-emergency or emergency condition. Operations and repairs are described for cases of:

(1) Extreme Storm

(2) Threatened Sabotage

(3) Sabotage

(4) Foundation or Structural Failure Prevention

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with the operation of the St. Anthony Falls locks and dam.

B-2 Definitions

a. Pre-emergency

A "Pre-emergency" condition is one in which some impending or existing threat to the safe operation of the dam or reservoir is identified but no significant hazard to life or property is expected to occur.

b. Emergency

An "Emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an emergency condition may be imminent or longer term.

c. Lockmaster

The term "Lockmaster" means the dam tender or the individual in charge at the St. Anthony Falls locks and dam project site.

d. Area Lockmaster

The term "Area Lockmaster means the person in charge of the Area Lockmaster's Office.

e. District

The term "District" identifies one of the following elements depending upon which is appropriate for the situation at hand.

(1) Emergency Operation Center. Provides a 24-hour telephone contact with District Office. Responsible for contacting the Dam Safety Officer, the Commander/District Engineer, and NCD. Also responsible for matters involving national security, disasters, and mobilization.

(2) Project Operations Branch. Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Responsible for keeping the Dam Safety Officer informed of the pre-emergency or emergency situation. Also, responsible for matters involving normal dam operations and/or matters not covered by the other District elements.

(3) Dam Safety Officer. The Dam Safety Officer must be kept informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required for the pre-emergency or emergency situation.

(4) Water Control Center. Part of Hydrology Section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving reservoir regulation.

(5) Geotechnical Design Section. A section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving the foundation stability of the dam.

(6) Design Branch. Responsible for matters involving the structural integrity of the locks and dam.

(7) Project Management Branch. Responsible for management support.

(8) Planning Division. Responsible for management support, and matters involving environmental analysis and cultural resources.

B-3. Basis of Activation

This subplan is to be activated immediately upon declaration of a pre-emergency or emergency condition. (See Appendix A, Emergency Identification Subplan for procedure of declaring a pre-emergency or emergency condition.)

B-4. Responsibilities

a. Lockmaster

(1) Provide information to District on existing severity and rate of change of problem.

(2) Request provision by District of needed assistance including:

(a) Personnel, including expert supervision.

(b) Equipment.

(c) Materials.

(3) Carry out operations and repairs as directed by District.

(4) Act independently to implement emergency operations and repairs in the event communications with the District are disrupted or immediate action is required including:

(a) Deciding the urgency of correction.

(b) Carrying out appropriate portions of the emergency operations and repairs subplan.

(c) Obtaining needed personnel, equipment and materials.

b. Area Lockmaster

(1) Provide personnel, equipment and materials to Lockmaster as directed by District.

(2) Direct emergency operations and repairs in the event communications between the Lockmaster and District are disrupted.

c. District

(1) Assess problem and Lockmaster's request for assistance with respect to:

(a) Urgency for correction.

(b) Type of corrective actions required.

(c) Personnel required for corrective actions including requirements for expert advice and/or on-site supervision.

(d) Equipment and materials required for corrective actions.

(2) Provide direction to the Lockmaster on emergency operations and repairs to be carried out.

(3) Dispatch needed personnel, equipment and materials to the project from the District.

(4) Arrange needed personnel, equipment and materials from sources other than District.

B-5. Emergency Operations and Repairs - Extreme Storm

a. Potential Problems.

Severe weather conditions over the watershed above St. Anthony Falls such as heavy rains and/or rapid snow melt are the primary cause of large floods on the Mississippi River. The Standard Project Flood computed for this site is presented in the main text of this plan. During flood events protective measures should taken when the upper pool elevation reaches 802. (The top of lock wall is at elevation 806.0).

b. Corrective Action.

A diversion dike is necessary between the lock wall and the bluff to prevent damage to the lock and adjacent areas. Other dikes may be needed to prevent the flood waters from causing damage to lock features.

The height of the dikes depends on the forecasted stages and the amount of time available to construct the dikes. The time required to build a dike of a given height is discussed in the following paragraphs.

c. Resources Required.

(1) Materials

Materials required for sandbag dikes include:

(a) Sandbags

(b) Sand

(c) Wood planks and stakes.

(2) Equipment

Shovels, wheelbarrows, hammer and nails are the primary equipment requirements for construction of sandbag dikes.

(3) Personnel

The number of personnel needed to build the dikes depends on the time available and the required dike height. Plate B-1 illustrates the time required to construct various height dikes with 25 persons. This may be useful for estimating requirements for other conditions also.

d. Technical Directions.

(1) Filling the Sacks

For sandbag dikes a completely filled sack is detrimental. Instead use a half filled sack (approximately 0.3 cubic feet of sand per bag).

When it is necessary to fill a large number of sacks in a short period of time, a sack rack should be used. One type of sack rack can be made by driving three stakes in the ground with their tops above the ground to the approximate height of the sack.

(2) Transporting the Sacks

Sandbags may be transported in wheelbarrows, handbarrows, by chains of people, or on people's shoulders.

Wheelbarrows are preferable as two filled sacks constitute a load for one wheelbarrow which can be handled by one person if smooth-run planks and a suitable grade are provided.

Handbarrows, carried by two people, can be used to transport two sack loads over longer distances. A handbarrow may be made of two hand bars and two sacks. The hand bars are two poles about 5 feet long, from 1 1/2" to 2" in diameter. Any local wood that has sufficient strength is suitable. The handbarrow is assembled by slipping the hand bars through the bottom corners of an empty sack, taking care not to slit the openings in the sack larger than necessary. The second sack is slipped on in a similar manner but, in the reverse direction so that

one sack is telescoped into the other. The sacks should be securely fastened to the hand bars by small nails.

If enough personnel are available a chain of people offers a fast means of transporting sacks. A line is formed between the sandbag filling site and the dike. Each sack is transported to the desired location by passing it between each person in the line (approximately 1 person for each 4 to 5 feet of distance).

(3) Placement of the Sacks

Plate B-2 illustrates proper placement of the sacks for a sandbag barrier or dike.

B-6. Emergency Operations and Repairs - Threatened Sabotage

a. Potential Problems

Threats of sabotage are most likely to be received from individuals or groups with little intention of carrying through with action. However, all such threats are to be taken seriously. Threats considered most probable to occur are those related to disruption of communications, blocking access to the project, and interference with project operations. Threats could also relate to damaging the dam or other key project features affecting safety.

b. Corrective Action

(1) All threats concerning the St. Anthony Falls locks and dam will be reported immediately to the Federal Bureau of Investigation and to the Chief of the Project Operations Branch. Others should be notified according to Appendix C.

(2) Immediate assistance to secure and protect the dams, dikes and appurtenant facilities will be requested in the event a threatened action could jeopardize the safety of project visitors and staff or downstream areas if carried out. Agencies from which law enforcement assistance can be obtained are listed in Table C-2.

(3) Every effort shall be made to operate the locks and dam so as to avoid injury to all parties. However, the possible catastrophic consequences of dam failure require that actions necessary to maintain the safety of the dam must not be compromised by persons seeking to block access to the site, limit headwater levels or releases, or otherwise impede essential operations.

B-7. Emergency Operations and Repairs - Sabotage

a. Potential Problems

Acts of sabotage may range from minor disruptions to quasi-military attacks by knowledgeable and well-equipped professionals. The effects of sabotage fall into one of three categories: a) not affecting safety of the dam; b) posing a minor or future safety problem; or c) posing an immediate, serious safety problem.

b. Corrective Actions

(1) All acts of sabotage will be reported immediately to the Federal Bureau of Investigation and to the Chief of the Project Operations Branch.

(2) Immediate remedial action shall be initiated in all cases of sabotage causing an imminent or future safety problem of a serious nature. As appropriate, remedial action shall include:

(a) Declaration of an emergency condition and activation of the Notification Subplan.

(b) Activation of the emergency drawdown if during low flow period (see paragraph B-8b).

(c) Initiation of emergency repairs according to the nature of damage.

B-8. Emergency Operations and Repairs - Foundation or Structural Failure Prevention

a. Potential Problems.

During periods of above normal pool, the foundation and structure should undergo close inspection to the extent possible. Assessment should be made of any significant changes in these features. Special attention should be directed toward problems affecting the foundation such as scour downstream of the dam and excessive seepage beneath the structure. Also, after periods of high pool, a close inspection should be made to assess significant changes in the structure or foundation. Problems are likely to be most readily observed as changes or non-uniformities in the appearance of the water surface passing over the spillway and through the stilling basin. Notification of any potential pre-emergency conditions or emergency conditions should be immediately made following the guidance in Appendix C.

b. Corrective Action.

The configuration of the features of this site limits the corrective actions that the lockmaster may carry out without

heavy equipment and assistance from the District Office. Due to the proximity to the District Office and the services available in this urban location corrective actions taken for the above problems will be taken in close cooperation with the District Office.

During periods of low flow it is possible to conduct an emergency drawdown of the upper pool by opening the lock valves and tainter gate and operating the Hennepin Island power plant turbines at full gate. This procedure is only effective when the river flow is less than the total capacity of these outlets or approximately 19,000 cfs. Consideration should be given to the damages that may occur to the lock during such a procedure.

A similar procedure may be used for an emergency drawdown of the intermediate pool. The lower dam tainter gates allow for a large discharge capacity. The total discharge capacity of the lower dam including the power plant discharge (5000 cfs) and the main lock capacity (approximately 10,000 cfs) is approximately 76,000 cfs. This assumes the pool elevation is 750.0 feet, the gates are out of the water and the tailwater is below the crest elevation.

B-9. Inventory of Resources

Resources available at the District level for carrying out emergency operations and repairs are listed in Table B-1.

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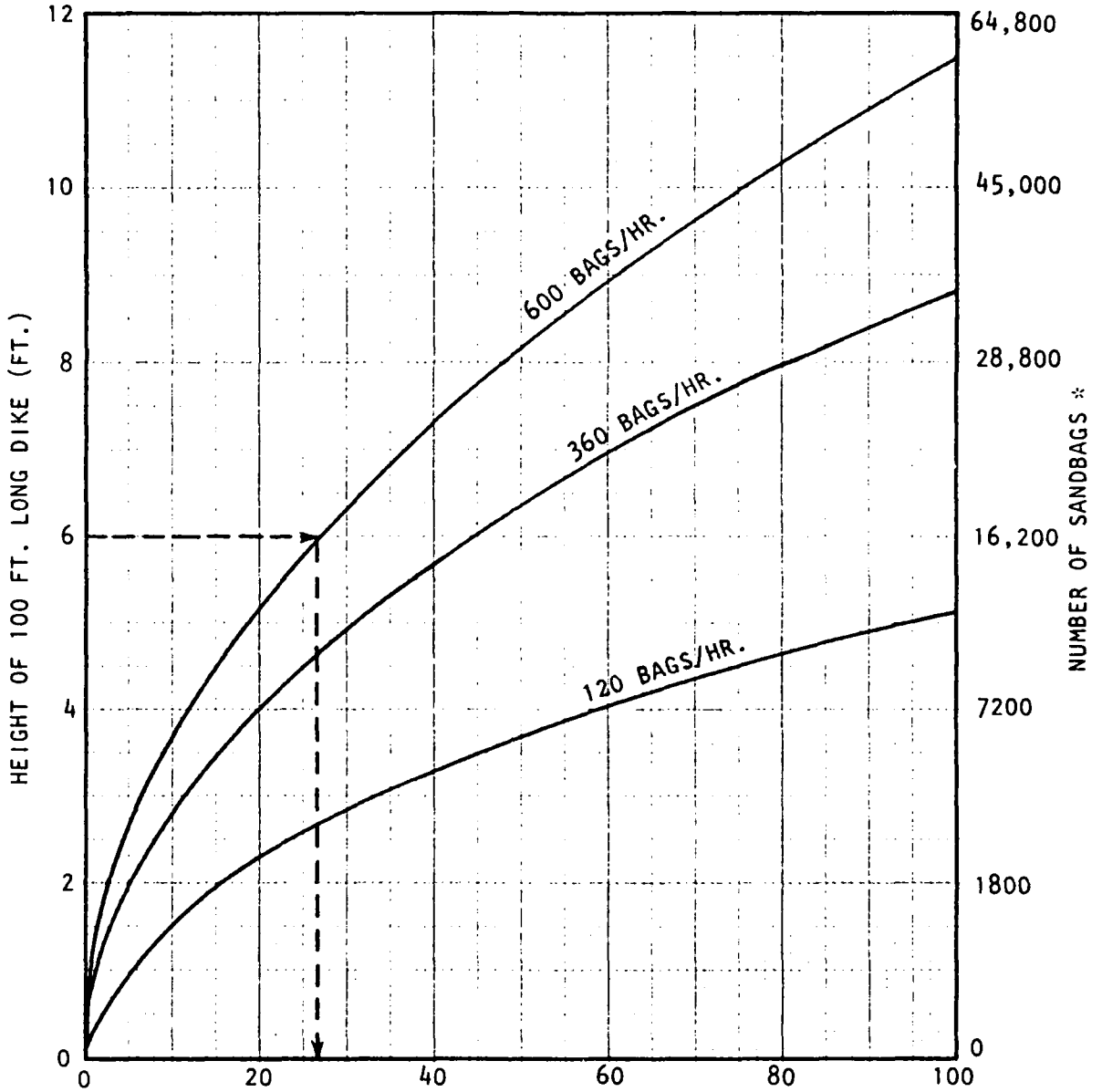
TABLE B-1
INVENTORY OF RESOURCES - DISTRICT LEVEL

Name of Resource	Type of Resource	Address	Phone Number
Brisson Pump Company	Pump Distributor	2359 E. Cowern Place N. St. Paul, MN 55109	612/777-3317
Tecumseh Products Company	Pump Distributor	P.O. Box 355 223 Curtis Street Delaware, Ohio 43015	614/369-9656
Kasten Schmidt Equipment Systems	Pump Distributor	455 Whitrock Avenue Wisc. Rapids, WI 54494	715/423-9221
The Crisafulli Pump Company, Inc.	Pump Distributor	Box 1051 Glendive, MT 59330	406/365-3393
Gator Pump, Inc.	Pump Distributor	P.O. Box 57 302 Corrigan Brownwood, TX 76801	800/351-1463
Cherne Industries, Inc.	Sewer Plugs/ Pipe Stoppers	5701 S. Co. Rd. 18 Minneapolis, MN 55436	612/933-5501
Goodyear Tire and Rubber Company	Sewer Plugs/ Pipe Stoppers	5100 W. 35th Street Minneapolis, MN	612/927-7381
Carlson Equipment Company	Sewer Plugs/ Pipe Stoppers	1380 W. Co. Rd. C St. Paul, MN 55113	612/633-8171
NB Products	Sewer Plugs/ Pipe Stoppers	35 Bevlah Road New Britain, PA 18901	215/345-1879
Miller Bag Co.	Sandbags	861 Hennepin Ave. E. Minneapolis, MN 55414	612/378-3200
Mac Katz Bag Co., Inc. (includes polyethylene sheeting)	Sandbags	P.O. Box 1666 Indianapolis, IN 46206-1666	317/635-9561
Independent Manufacturers Marketing Service	Sandbags	1543 Holton Street St. Paul, MN 55108	612/644-2007
Berg Bag Company	Sandbags	410 3rd Avenue North Minneapolis, MN 55401	612/922-3286
Northwest Bag Corporation	Sandbags	400 3rd Avenue North Minneapolis, MN 55401	612/379-0305
Volm Bag Company, Inc.	Sandbags	2200 Mary Hills Drive Golden Valley, MN	612/588-3232
Minneapolis Bag & Barrel Company	Sandbags	Lumber Exchange Bldg.	612/333-1459
Central Bag Company	Sandbags	1323 W. 13th P.O. Box 4044 Kansas City, MO 64101	612/471-0388
Dan-Dee Equipment, Inc.	Sandbagging Equipment	P.O. Box 125 Honey Creek, WI 53138	414/534-3138
Bemis Company, Inc. Packaging Service	Sandbagging Equipment	315 27th Ave. N.E. Minneapolis, MN 55418	612/340-6200

66P



* ASSUMES 3 BAGS PER CUBIC FOOT OF SAND

NOTE: Sandbag placement rates vary depending on working conditions. A reasonable range is given in the graph. In the initial stages of a dike construction a placement rate may be estimated. This estimate may be used in the graph to establish the completion time.

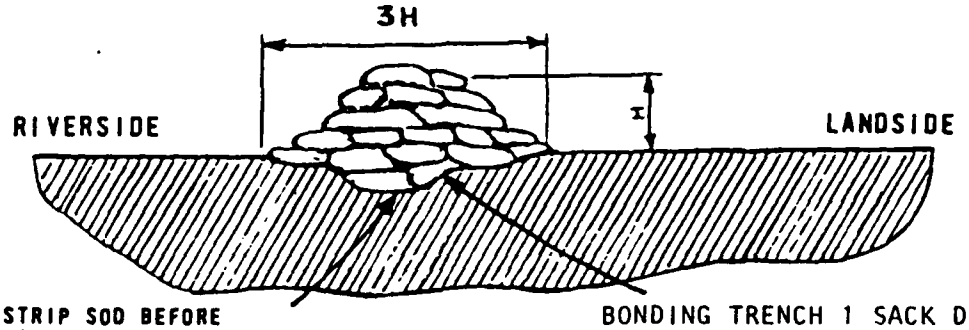
EXAMPLE: To build a 6 foot high dike as shown in Plate B-2 it will require approximately 27 hours if it is estimated that the bags will be placed at a rate of 600 bags per hour.

CORPS OF ENGINEERS, U.S. ARMY
ST. PAUL ENGINEERING DISTRICT
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS
EMERGENCY PLAN
TIME REQUIRED FOR SANDBAG
DIKE CONSTRUCTION

(UPPER MISSISSIPPI RIVER BASIN)
1987

PLATE B-1



SECTION

BONDING TRENCH 1 SACK DEEP, 2 SACKS WIDE (DISREGARD FOR PLACEMENT ON CONCRETE OR ASPHALT SURFACES)

NOTE:

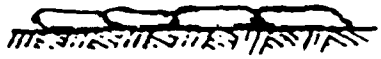
ALTERNATE DIRECTION OF SACKS WITH BOTTOM LAYER PARALLEL TO FLOW, NEXT LAYER PERPENDICULAR TO FLOW, ETC.

LAP UNFILLED PORTION UNDER NEXT SACK.

TYING OR SEWING SACKS NOT NECESSARY.

TAMP THOROUGHLY IN PLACE.

SACKS SHOULD BE APPROXIMATELY 1/2 FULL OF SAND.



METHOD OF LAPPING SACKS

CORPS OF ENGINEERS, U.S. ARMY
ST. PAUL ENGINEERING DISTRICT
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS EMERGENCY PLAN

SANDBAG DIKE

(UPPER MISSISSIPPI RIVER BASIN)

1987

PLATE B-2

EMERGENCY NOTIFICATION SUBPLAN

APPENDIX C

TO

EMERGENCY PLAN

FOR

THE LOCKS AND DAMS AT ST. ANTHONY FALLS

MINNEAPOLIS, MINNESOTA

March, 1987

TABLE OF CONTENTS

LIST OF TABLES

EMERGENCY NOTIFICATION SUBPLAN
FOR THE LOCKS AND DAMS AT ST. ANTHONY FALLS
MINNEAPOLIS, MINNESOTA

C-1. Introduction

Conditions affecting operation of the St. Anthony Falls locks and dam could result in a hazard to life and/or property due to high reservoir levels as the result of design floods and/or sudden release of large volumes of water. Prompt issuance of appropriate notifications, is essential for minimizing hazards to life and property.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for issuing notifications of impending and existing emergencies affecting the operation and safety of the St. Anthony Falls locks and dam.

b. Scope

This subplan specifies notifications and other actions to be taken upon declaration of a pre-emergency or emergency condition. Notifications and actions specified are those necessary for:

(1) Ensuring safety.

(2) Vacating project areas where emergency operations and repairs may be conducted.

(3) Internal coordination of Corps of Engineers activities.

(4) Coordination with non-federal units of government and other Federal agencies.

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with operation of the St. Anthony Falls locks and dam.

C-2. Definitions

a. Pre-emergency

A "Pre-emergency" condition is one in which some impending or existing threat to the safe operation of the dam or reservoir

is identified but no significant hazard to life or property is expected to occur.

b. Emergency

An "Emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an emergency condition may be imminent or longer term.

c. Lockmaster

The term "Lockmaster" means the dam tender or the individual in charge at the St. Anthony Falls locks and dam.

d. Area Lockmaster Office

The term "Area Lockmaster" means the person in charge of the Area Lockmaster's Office.

e. District

The term "District" identifies one of the following elements depending upon which is appropriate for the situation at hand.

(1) Emergency Operation Center. Provides a 24-hour telephone contact with District Office. Responsible for contacting the Dam Safety Officer, the Commander/District Engineer, and NCD. Also responsible for matters involving national security, disasters, and mobilization.

(2) Project Operations Branch. Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Responsible for keeping the Dam Safety Officer informed of the pre-emergency or emergency situation. Also responsible for matters involving normal dam operations and/or other matters not covered by the other District elements.

(3) Dam Safety Officer. The Dam Safety Officer must be kept informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required for the pre-emergency or emergency situation.

(4) Water Control Center. Part of Hydrology Section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving reservoir regulation.

(5) Geotechnical Design Section. A section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving the foundation stability of the dam.

(6) Design Branch. Responsible for matters involving the structural integrity of the locks and dam.

(7) Project Management Branch. Responsible for management support.

(8) Planning Division. Responsible for management support, and matters involving environmental analysis and cultural resources.

C-3. Basis of Activation

This subplan is to be activated immediately upon declaration of a pre-emergency or emergency condition.

C-4. Parties to be Notified

a. Corps Offices

Corps Offices to be notified of all pre-emergency or emergency conditions that are declared are listed in Table C-1.

b. Other Parties

Other parties to be notified according to the nature of an emergency or pre-emergency condition are listed in Table C-2.

C-5. Responsibility for Notification

Notifications listed in Tables C-1 and C-2 are the responsibility of the office (Lockmaster, Area Lockmaster, or District) making the declaration of a pre-emergency or emergency condition. Assistance in making notifications may be requested from other Corps offices and/or other parties. In the event all communications between offices are disrupted after declaration of a pre-emergency or emergency declaration, each office will assume responsibility for making all notifications.

C-6. Communications

a. Corps Offices

(1) Normal

Communications between the District and Lockmaster, are normally by radio. Radios at the Central Control Station and District's Emergency Operating Center will be manned on a 24-hour basis during all flood emergencies and whenever a pre-emergency or emergency condition is in effect. Information on radio frequencies and call letters for key contacts are listed in Table C-1.

(2) Back-Up

The telephone communications network between the District Office, project administration office and Area Lockmaster will be used to back-up radio communications. Telephones at each office will be manned as required during all flood emergencies and whenever a pre-emergency or emergency condition is in effect and radio service is disrupted. (Office and home phone numbers of key Corps personnel are listed in Table C-1).

(3) Emergency

During a situation when both radio and telephone communications between the District Office and project area are lost, others equipped with radio or telephone facilities will be called on for assistance. Those to whom application for assistance may be made are identified in Table C-2 along with telephone numbers.

b. Other Parties

(1) Normal

Communications with other parties will normally be by telephone. Office and home phone numbers of key contacts are listed in Table C-2.

(2) Back-Up

Communications with other parties will be by radio in the event telephone service is disrupted. Table C-2 also lists those parties which can be requested to forward notifications to offices lacking radio equipment.

C-7. Timing of Notifications

Parties listed in Table C-1 are to be notified as soon as possible after declaration of a pre-emergency or emergency condition. Notifications listed in Tables C-2 are dependent on reservoir water elevation and other conditions and should be made as soon as a high probability of the eventual need for notification is predicted.

C-8. Content of Notification Messages

a. Corps Offices

Notifications are to include the key information needed as a basis for decision making and/or action including, as appropriate and to the extent possible, the following:

(1) Description of Situation

(a) Nature and severity of problem(s).

(b) Current and predicted reservoir conditions including water elevation, inflow and discharge.

(c) Current and forecasted weather conditions.

(2) Action Planned or Underway

(a) Type of corrective actions.

(b) Estimated time to complete corrective actions.

(c) Outlook for success.

(d) Assistance required/being furnished.

(e) Potential complications.

(f) Recommended evacuation.

(3) Other

(a) Staff at dam site.

(b) Visitors at project.

(c) Road conditions.

b. Other Parties

Notification messages are to include a description of the nature of impending or existing hazard, potential timing of its occurrence, and recommendations for evacuation and other action (needed evacuation on project lands managed by the Corps will be directed rather than recommended).

C-9. Pre-emergency Actions

a. Lockmaster

For a Lockmaster declared pre-emergency or suspect pre-emergency situation, the Lockmaster must notify the Area Lockmaster in accord with paragraph C-5, Table C-1.

If contact with the Area Lockmaster cannot be made, contact the Dam Safety Officer, Project Operations Branch, and Emergency Operations Center as shown in Table C-1.

Also notify Northern States Power Company, Table C-2.

b. Area Lockmaster

Evaluate the situation and declare a pre-emergency condition if warranted.

Notify Dam Safety Officer, Project Operations Branch, and Emergency Operations Center in accord with paragraph C-5, Table C-1 and insure the notification of Northern States Power Company, Table C-2.

Provide assistance as needed to Lockmaster and District Office.

c. District

(1) Dam Safety Officer

The Dam Safety Officer is to be kept informed of all conditions of the pre-emergency situation. Responsibilities include:

Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the pre-emergency situation.

Evaluate the situation and declare a pre-emergency condition if warranted.

Notify the North Central Division Dam Safety Officer in accord with paragraph C-5 if the pre-emergency condition was declared by the Lockmaster, Area Lockmaster or District Office.

Notify the Dam Safety Committee, the Emergency Operations Center and the Project Operations Branch of the situation.

(2) Project Operations Branch

Must be kept informed of all pre-emergency situations. Responsibilities include:

Responsible for identifying a person-in-charge of the pre-emergency situation. Also, responsible for matters involving normal dam operations and/or any other matters not covered by other District elements.

Responsible for contacting the Dam Safety Officer for engineering and technical assistance and keeping him informed of the situation. Also, contact the Emergency Operations Center and keep them informed of the situation.

Evaluate the situation and declare a pre-emergency condition if warranted.

Provide needed assistance and/or instructions to the Area Lockmaster, Lockmaster and person-in-charge of the pre-emergency situation.

(3) Emergency Operations Center

Must be kept informed of all pre-emergency situations. Responsibilities include:

Twenty-four (24) hour telephone service.

Responsible for contacting Dam Safety Officer, Project Operations Branch, District Engineer, Public Affairs, and the NCD Emergency Manager.

Responsible for matters involving National Security, Disasters, and Mobilization. Provide emergency response in accordance with ER 500-1-1, National Disaster Procedures.

Evaluate the situation and declare a pre-emergency condition if warranted.

(4) Others

The District personnel listed under this category in Table C-1 are only to be contacted if none of the above District Elements could be reached. Responsibilities include:

Evaluate the pre-emergency conditions and declare a pre-emergency condition if warranted.

If the Project Operations Branch cannot be contacted, appoint a temporary person-in-charge of the pre-emergency situation.

Provide needed assistance and/or instructions to Area Lockmaster, Lockmaster and person-in-charge of the pre-emergency situation.

C-10. Emergency Actions

The order in which the following emergency actions are to be performed would depend on the type and timing of occurrence of the emergency situation. Priority should always be given to the immediate safety of any endangered human life. For example, in the case of a failure at normal pool, low tailwater; since this situation provides the greatest hazard to life and is the fastest occurring, the Lockmaster would first want to follow step 5 and take action to notify and evacuate areas in the vicinity of the lock and dam area. Then the Lockmaster would proceed with the other emergency actions and notifications.

a. Lockmaster

(1) For a Lockmaster declared emergency, the Lockmaster must notify the Area Lockmaster in accord with paragraph C-5 and Table C-1.

If contact with the Area Lockmaster cannot be made, contact the Dam Safety Officer, Project Operations Branch, and Emergency Operations Center as shown in Table C-1.

Also notify Northern States Power Company, Table C-2.

(2) Cancel normal work schedule and provide for 24-hour duty as needed.

(3) Assess project areas which are or may become unsafe including, but not limited to:

(a) Reservoir water surface.
(b) Day use and recreational areas within project boundaries including those managed by others.

(4) Identify areas required for conduct of emergency operations and repairs, including any necessary access routes

(5) Take action to notify and evacuate areas which are unsafe, potentially unsafe, or where emergency operations and repair work may be carried out including, as appropriate.

(a) Directing evacuation of affected project areas managed by the Corps.

(b) Closing project roads to incoming traffic.

(c) Moving equipment to safe areas.

(6) Request assistance as needed in carrying out items (5)(a) and (5)(b) above from agencies listed in Table C-2.

(7) Assume District responsibilities for notifications if emergency condition was declared by Lockmaster.

(8) Verify appropriate warnings if announced over local radio and television.

b. Area Lockmaster

Evaluate the situation and declare an emergency condition if warranted.

Notify Dam Safety Officer, Project Operations Branch, and Emergency Operations Center in accord with Paragraph C-5 and

Table C-1 and insure notification of Northern States Power Company, Table C-2.

Provide assistance to Lockmaster or District as required to accomplish the following tasks:

(1) Cancel normal work schedule and provide for key staff as needed.

(2) Assess project areas which are or may become unsafe including, but not limited to:

(a) Reservoir water surface.

(b) Day use and recreational areas within project boundaries including those managed by others.

(3) Identify areas required for conduct of emergency operations and repairs including any necessary access routes.

(4) Take action to notify and evacuate areas which are unsafe, potentially unsafe, or where emergency operations and repair work may be carried out including, as appropriate.

(a) Directing evacuation of affected project areas managed by the Corps.

(b) Closing project roads to incoming traffic.

(c) Moving equipment to safe areas.

(5) Request assistance as needed in carrying out items (4)(a) and (4)(b) above, from agencies listed in Table C-2.

(6) Assume District responsibilities for notifications if emergency condition was declared by Lockmaster.

(7) Verify that appropriate warnings are announced over local radio and television.

c. District

(1) Dam Safety Officer

(a) The Dam Safety Officer is to be kept informed of all conditions of the emergency situation.

(b) Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the emergency situation.

(c) Evaluate the situation and declare an emergency condition if warranted.

(d) Notify the North Central Division Dam Safety Officer in accordance with paragraph C-5 if an emergency condition was declared by the Lockmaster, Area Lockmaster, or District Office.

(e) Notify the Dam Safety Committee, the Emergency Operations Center and the Project Operations Branch of the situation.

(2) Project Operations Branch

(a) Must be kept informed of all emergency situations.

(b) Responsible for identifying a person-in-charge of the emergency situation. Also, responsible for matters involving normal Dam Operations and/or any other matters not covered by other District elements.

(c) Responsible for contacting the Dam Safety Officer for engineering and technical assistance and keeping him informed of the situation. Also, contact the Emergency Operations Center and keep them informed of the situation.

(d) Evaluate the situation and declare an emergency condition if warranted.

(e) Provide needed assistance and/or instructions to the Area Lockmaster, Lockmaster, and person-in-charge of the emergency situation.

(f) Cancel normal work schedule and provide for key staff as needed.

(g) Determine which of the planning conditions (SPF without failure or SPF with failure or normal pool low tailwater dam failure) best represents potential inundation and needs for evacuation.

(h) Determine need for warning of high reservoir levels.

(i) Formulate and issue warning message(s) to affected non-federal parties in accord with paragraph C-6.

(j) Verify appropriate warnings as released over local radio and television.

(3) Others

(a) The District personnel listed under this category in Table C-1 are only to be contacted if none of the above District personnel could be reached.

(b) Evaluate the emergency conditions and declare an emergency condition if warranted. Notify the Dam Safety Officer, the Emergency Operations Center and the Project Operations Branch as soon as possible.

(c) If the Project Operations Branch cannot be contacted, appoint a temporary person-in-charge of the emergency situation.

(d) Provide needed assistance and/or Instructions to Area Lockmaster, Lockmaster, and person-in-charge of the pre-emergency situation.

d. North Central Division

Notify the Office of the Chief of Engineers and other Federal agencies as appropriate.

e. Office of the Chief of Engineers

Notify other Federal agencies as appropriate, such as the Federal Emergency Management Agency.

C-11. Example Messages

Preparation of warning messages should begin as soon as their potential need is apparent so that they can be issued promptly upon declaration of an emergency condition. When time is available, all public notices should be released by the Public Affairs Office (PAO) or contact Emergency Management or the Electronic Service Center, if the PAO cannot be reached (see Table C-1). In some cases, an emergency condition may be declared with little or no advance notice. The following example messages provide a model for the first announcements in such cases. The Public Affairs Office would then be contacted as soon as time permits. They would release subsequent announcements to provide additional details.

a. Announcement for Slowly Developing Conditions

THE AREA CORPS OF ENGINEERS AT ST. PAUL ANNOUNCED AT (time) TODAY THAT AN EMERGENCY CONDITION EXISTS AT (name of dam) DAM DUE TO (general description of problem). THE DAM IS LOCATED ON (stream) ABOUT (distance) MILES UPSTREAM OF (name of downstream community and state).

A CORPS SPOKESMAN SAID THAT THE WATER LEVEL OF (name of reservoir) WAS BEING LOWERED (as a precautionary measure/to reduce pressure on the dam/to enable repair work).

THE SPOKESMAN EMPHASIZED THAT THE DRAWDOWN OF THE POOL WAS BEING CARRIED OUT UNDER CONTROLLED CONDITIONS AND THERE IS NO IMMEDIATE DANGER OF THE DAM FAILING. HOWEVER, THE LARGE RELEASES OF WATER THAT ARE BEING MADE MAY CAUSE FLOODING ALONG

(stream). RESIDENTS OF LOW LYING AREAS ALONG (stream) SHOULD (evacuate/be alert for high water and prepared to evacuate).

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

b. Announcement for Rapidly Developing Conditions

URGENT: THE ARMY CORPS OF ENGINEERS HAS ANNOUNCED THAT (name of dam) DAM IS IN IMMINENT DANGER OF FAILURE. THE DAM IS LOCATED ABOUT (distance) MILES UPSTREAM OF (name of downstream community and state).

ATTEMPTS TO SAVE THE DAM ARE UNDERWAY BUT THEIR SUCCESS CANNOT BE DETERMINED AS YET. RESIDENTS ALONG THE (stream) SHOULD EVACUATE TO HIGH GROUND IMMEDIATELY. RESIDENTS ALONG THE (stream) IN THE VICINITY OF (city) AND DOWNSTREAM SHOULD REMAIN ALERT FOR FURTHER INFORMATION.

IF THE DAM FAILS, WATER WILL TAKE APPROXIMATELY (time) HOURS TO REACH THE LOWER END OF (city, stream, etc.). AREAS CLOSER TO DAM WILL BE FLOODED SOONER.

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

c. Announcement for High Reservoir Levels

THE ARMY CORPS OF ENGINEERS AT ST. PAUL ANNOUNCED AT (time) TODAY THAT AN EMERGENCY CONDITION EXISTS AROUND (name of reservoir) DUE TO EXPECTED HIGH WATER LEVELS. THE LAKE IS LOCATED ON (stream) ABOUT (distance) MILES UPSTREAM OF (community and state).

THE CORPS SPOKESMAN SAID THAT THE WATER LEVEL IN THE LAKE WAS EXPECTED TO REACH ELEVATION (elevation) AT (time). DUE TO (general description of problem). THIS WATER LEVEL WILL (describe major effects).

LARGE RELEASES OF WATER ARE BEING MADE FROM THE DAM IN AN ATTEMPT TO CONTROL THE LAKE LEVEL. RESIDENTS OF LOW LYING AREAS ALONG (stream) SHOULD BE ALERT TO POSSIBLE FLOODING AND PREPARE TO EVACUATE.

FURTHER INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

TABLE C-1
NOTIFICATION LIST FOR CORPS OF ENGINEERS OFFICES (INTERNAL)

OBSERVER

1. Observer potential dam problem.
2. Gather pertinent facts to describe situation.
3. Assess whether slowly developing, rapidly developing or imminent failure.
4. Notify first available lockmaster in order shown.

(If contact cannot be made with Lockmasters listed below, contact the Dam Safety Officer, Project Operations Branch, or Emergency Operations Center as shown on the attached list.)

LOCKMASTER

	Office	Home Phone	Radio
Robert Stahl	(612)332-6864	(612)757-2299	SSB/FM WUD614
Joseph Dvorak	(612)332-5336	(612)432-6116	SSB/FM WUD611

1. Assess observer's report.
2. Take necessary emergency actions.
3. Notify Area Lockmaster, Dam Safety Officer, Project Operations Branch, or Emergency Operations Center.

AREA LOCKMASTER

	Office	Home Phone	Radio
Arden Duval	(612)725-7032	(612)731-9650	FM WUD-62

1. Assess the situtation.
2. Take necessary emergency actions.
3. Notify Dam Safety Officer, Project Operations Branch, or Emergency Operations Center.

2 of 4 3 of 4 4 of 4
(REFER TO SHEETS)

TABLE C-1
NOTIFICATION LIST FOR CORPS OF ENGINEERS OFFICES (INTERNAL)

PROJECT OPERATIONS BRANCH

	Office	Home Phone
Dennis Cin	(612)220-0320	(612)455-6786
Thomas Oksness	(612)220-0322	(612)439-0272
Dennis Erickson	(612)220-0325	(612)452-6850

Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving normal dam operations, and/or matters not covered by other District elements. Project Operations Branch will contact Dam Safety Officer for engineering and technical assistance and keep him informed of situation.

OTHER DISTRICT PERSONNEL

Office	Office	Home Phone	Radio	
Upper Area Lockmaster				
Arden Duval	(612)455-3194	(612)731-9650	FM	WUD 62
Central Area Lockmaster				
Wallace Voss	(608)687-9033	(507)454-5044	FM	WUD 63
Lower Area Lockmaster				
Al Mathews	(507)895-4133	(608)782-0589	FM	WUD 64
Lockmaster				
USAF/Stahl	(612)333-5336	(612)757-2299	FM/SSB	WUD 611
LSAF/Stahl	(612)332-3660	(612)757-2299	FM/SSB	WUD 614
L&D 1/Worth	(612)724-2971	(612)779-6122	FM/SSB	WUD 601
L&D 2/Yule	(612)437-3150	(507)645-6814	FM/SSB	WUD 602
L&D 3/Hawkenson	(612)338-5794	(612)388-6425	FM/SSB	WUD 603
L&D 4/Duren	(608)685-4421	(608)685-4807	FM/SSB	WUD 604
L&D 5/Helmueler	(507)689-2101	(608)248-2510	FM/SSB	WUD 605
L&D 5A/Farrand	(507)452-2789	(608)687-4053	FM/SSB	WUD 615
L&D 6/Weyant	(608)534-6424	(608)534-6377	FM/SSB	WUD 606
L&D 7/McDonald	(507)895-2170	(507)895-2978	FM/SSB	WUD 607
L&D 8/Horstman	(608)689-2625	(608)457-2784	FM/SSB	WUD 608
L&D 9/Hiam	(608)874-4311	(608)734-3689	FM/SSB	WUD 609
L&D 10/Pedretti	(319)252-1261	(319)252-1044	FM/SSB	WUD 610

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

DAM SAFETY OFFICER*

	Office	Home Phone
Robert Post	(612)220-0303	(612)437-1316
William Goetz	(612)220-0310	(612)454-3722
Stan Kumpula	(612)220-0304	(612)484-8957

To be informed of all pre-emergency or emergency situations. responsible for identifying and/or providing the necessary engineering or technical support required to resolve the pre-emergency or emergency situation.

DAM SAFETY COMMITTEE

	Office	Home Phone
William Goetz	(612)220-0310	(612)454-3722
Helmer Johnson	(612)220-0602	(612)633-7791
Robert Engelstad	(612)220-0610	(612)459-6343
Robert Fletcher	(612)220-0510	(612)484-4998
Dennis Cin	(612)220-0320	(612)455-6786
Dale Mazar	(612)220-0444	(612)631-1940
Stan Kumpula	(612)220-0304	(612)484-8957

NCD DAM SAFETY OFFICER*

	Office	Home Phone
Zane Goodwin*	(312)353-6311	(312)823-4606
Carl Cable	(312)353-6372	(312)357-4529
Don Leonard	(312)353-6355	(312)359-3372
Lee Hoglind	(312)353-6358	(312)579-0148

OCE DAM SAFETY OFFICER*

	Office	Home Phone
Lloyd Duscha	(202)272-0382	(703)860-1319
William McCormick	(202)272-0397	(703)569-4323
Jack Thompson	(202)272-0215	(703)978-5627
Edward Prickett	(202)272-0207	(301)865-5876
Robert Smith	(202)272-0220	(703)569-3128
Earl Elker	(202)272-8500	(301)465-2120
John Elmore	(202)272-0196	(703)339-8279
Chief, Hydraulics and Hydrology Division	(202)272-0228	

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

EMERGENCY OPERATIONS CENTER

	Office	Home Phone
District EOC	(612)220-0208	(24-hr. Number)
David Christenson	(612)220-0204	(612)690-5749

Twenty-four (24) hour telephone service. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving national security, disasters, mobilization or NWR flood forecasts. Center will contact Dam Safety Officer, the Commander/District Engineer and NCD.

DISTRICT ENGINEER

	Office	Home Phone
Col. Joseph Briggs	(612)220-0300	(612)894-7142

PUBLIC AFFAIRS OFFICE

	Office	Home Phone
Kennon Gardner	(612)220-0201	(612)884-9023
24-Hr. Answer Machine	(612)220-0200	

NCD EMERGENCY MANAGER

	Office	Home Phone
Natural Disaster Planner Bernard Bochantin	(312)353-5275	(815)568-7544
Chief Emergency Management Tim Monteen	(312)886-8451	(312)961-2195

DISTRICT RADIO

Contact Electronic Service Center at	(612)437-2210	WUD6
SSB Primary		5400Khz
1st Alternate		6020Khz
Emergency		5015KhzLSB

For additional information see Appendix CNCS 500-1-1.

INUNDATION MAPS

APPENDIX D

TO

EMERGENCY PLAN -

FOR

THE LOCKS AND DAMS AT ST. ANTHONY FALLS

MINNEAPOLIS, MINNEASOTA

March, 1987

TABLE OF CONTENTS

LIST OF PLATES

INUNDATION MAPS
FOR THE LOCKS AND DAMS AT ST. ANTHONY FALLS
MINNEAPOLIS, MINNESOTA

D-1. Introduction

The attached maps indicate the area which would be flooded under the hypothesized conditions of: (a) occurrence of a Standard Project Flood at lock and dam 1; and (b) occurrence of a failure of the dam concurrent with a Standard Project Flood. The possibility is extremely remote that either condition will occur.

Preparation of the maps does not reflect on the safety or integrity of the St. Anthony Falls locks and dam. They have been prepared as part of a national program to prepare similar maps for all Federal dams.

D-2. Explanation of Plates

The areas inundated by the Standard Project Flood (SPF) with failure and without failure of the upper and lower dams are presented in Plates D-1 and D-2. Plate D-1 is an index map which shows the location of inundation map on Plate D-2. Since the peak water surface elevation for the SPF with dam failure, is only slightly greater than without dam failure, separate flood outlines cannot be shown at this map scale. The flood outline shown on the inundation maps and identified as with dam failure actually represents both conditions.

The peak flood time of the SPF is shown in Table D-1 on Plate D-1. The peak flood time is the time interval from the point at which the dam becomes uncontrolled until the peak discharge and water surface elevation occurs. With a flood as large as the SPF, flood damage may begin 5 to 6 days prior to the SPF peak.

D-3. Use of Maps

The attached maps provide a basis for evaluating existing evacuation plans for the affected area and development of any further plans which are needed. The Corps of Engineers recommends that such evaluations be made and any needed supplemental plans be developed. Information on evacuation planning and examples of evacuation plans are available from the Corps of Engineers.

The general procedure for use of the attached maps is as follows:

a. Determine the portion of your area of concern which would be affected by inundation or isolation.

b. Identify routes which would be used for movement of people from each part of the area to be evacuated.

c. Identify the amount of time available for evacuation.

d. Use the information to assess whether existing evacuation plans cover all of the affected area and will provide for timely evacuation.

D-4. Definition of Terms

River Mile - The distance along the channel of the Mississippi River measured from its confluence with the Ohio River.

Peak Flood Time - Elapsed time after assumed event until peak elevation occurs. Elapsed time for the case of Standard Project Flood without dam failure is measured from the time at which the peak discharge occurs at the dam. Elapsed time for the case of Standard Project Flood with dam failure is measured from the beginning of dam failure.

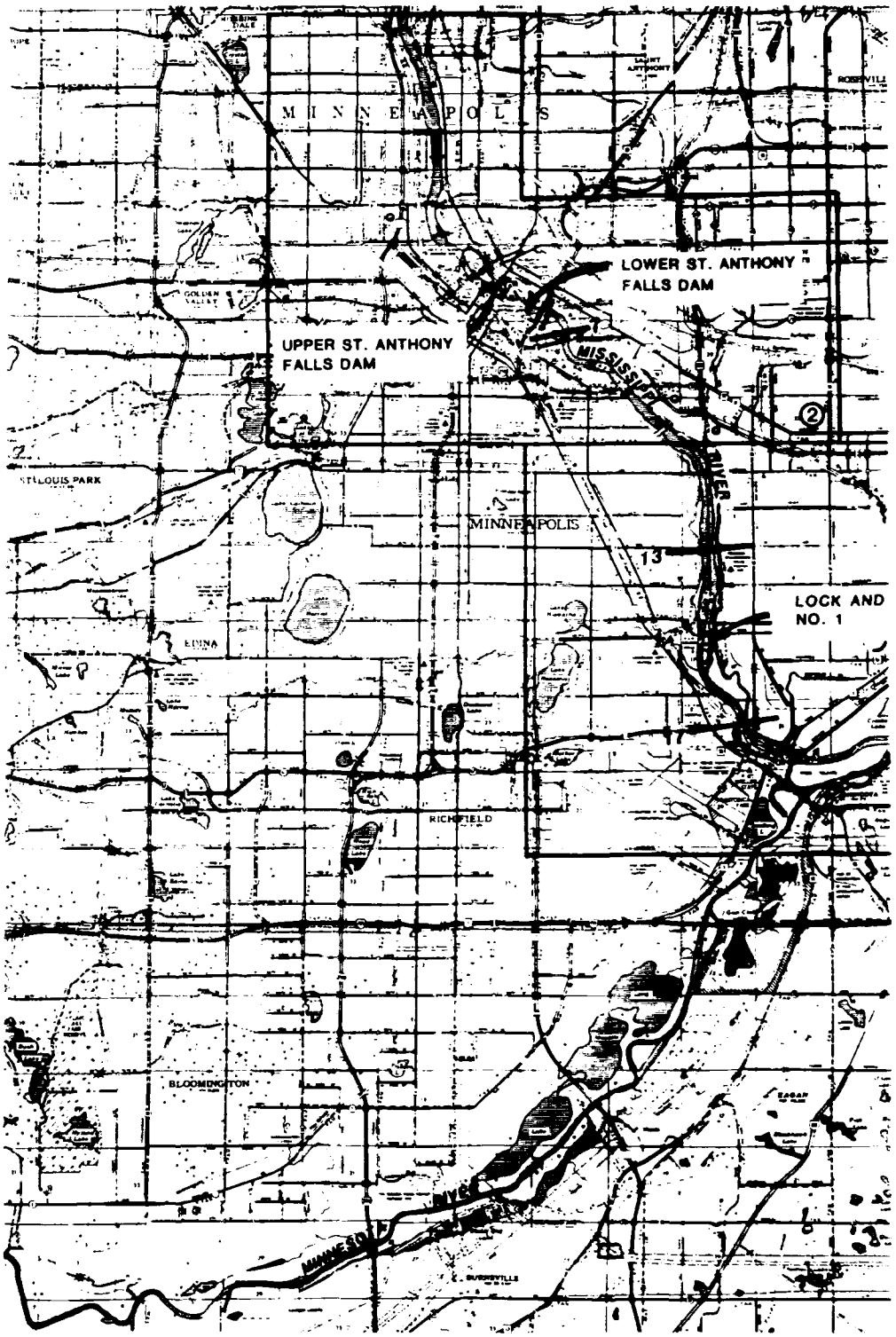
Distance from Dam - The distance along the channel upstream or downstream from the dam.

Peak Elevation - The computed maximum water surface elevation which would be reached at a location due to assumed conditions. Datum is the 1912 adjustment mean sea level (NGVD).

Cross-Section - Point at which the shape of a stream channel or valley is measured, usually in a direction perpendicular to the direction of flow.

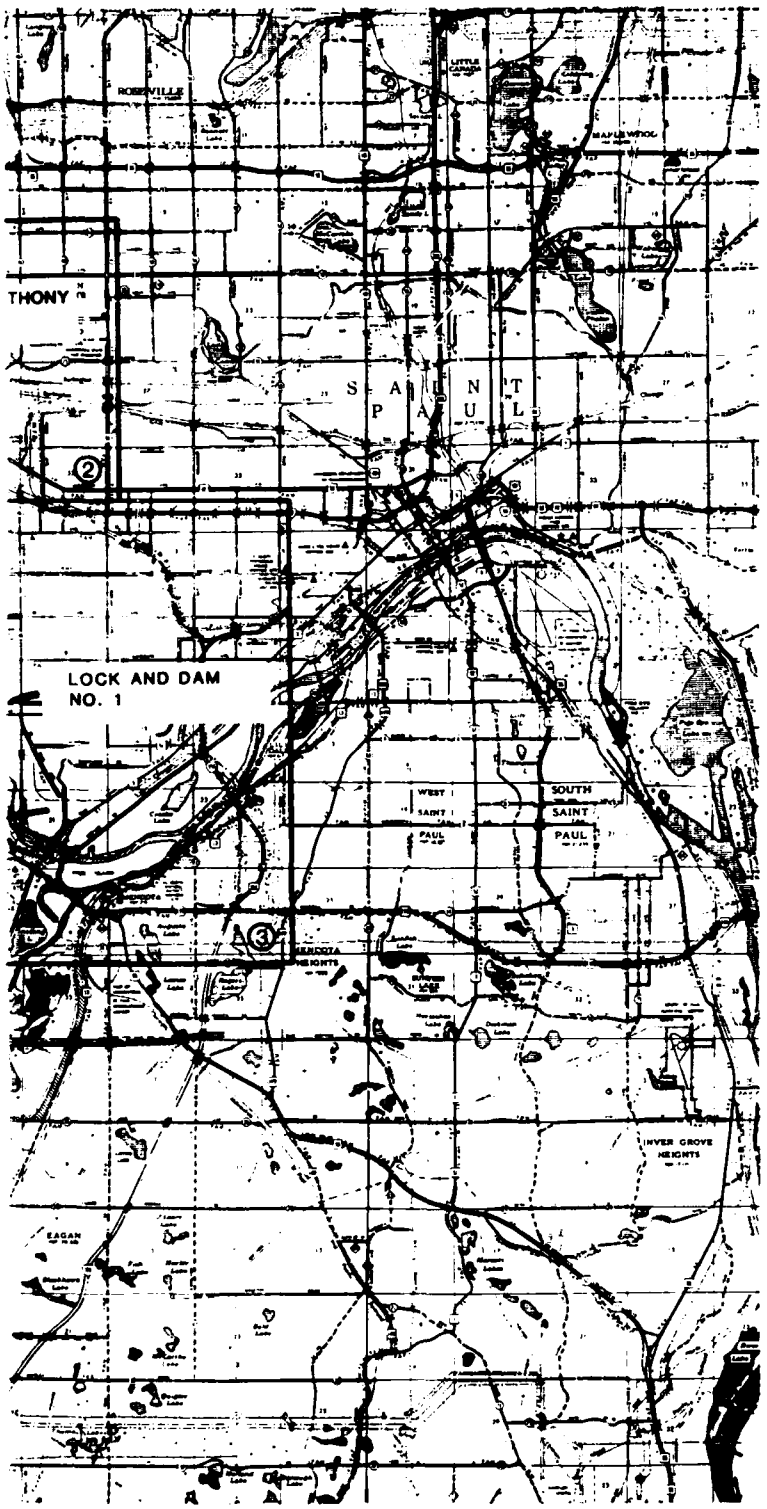
NGVD - National Geodetic Vertical Datum (distance above mean sea level).

1



CROSS SECTION DATA

PLATE NUMBER	SECTION NUMBER	RIVER MILE	DISTANCE FROM DAM	STANDARD PROJECT FLOOD WITHOUT DAM FAILURE PEAK FLOOD TIME	WITHOUT DAM FAILURE PEAK ELEVATION	WITH DAM FAILURE PEAK FLOOD TIME	WITH DAM FAILURE PEAK ELEVATION
2	7	852.8	0.6	0 HRS. 15 MIN.	744.5	0 HR. 15 MIN.	746.8
3	13	848.9	4.5	1 HR. 0 MIN.	740.3	0 HR. 45 MIN	741.7
3	17	846.4	7.0	1 HR. 45 MIN.	722.0	1 HR. 0 MIN.	722.8



NORTH

LEGEND

Inundation Map Plate No. ○ — Locations of Map Panels

— 20 Cross Section

0 1 2 3 4
SCALE IN MILES

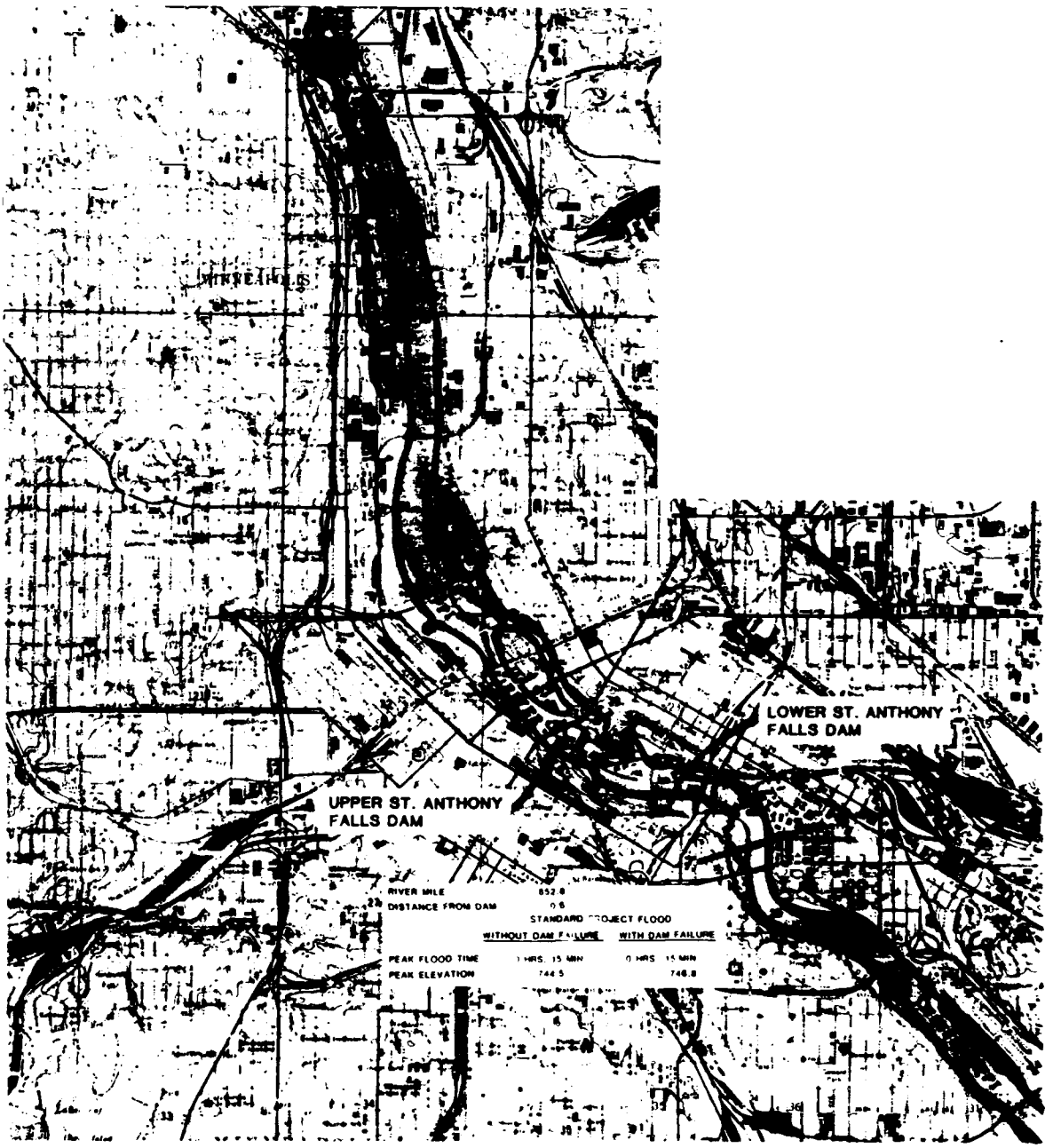
U.S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS DAMS EMERGENCY PLAN

INDEX MAP

JUNE 1986

PLATE D-1


LOWER ST. ANTHONY FALLS DAM
UPPER ST. ANTHONY FALLS DAM
RIVER MILE 852.8
DISTANCE FROM DAM 0.5
STANDARD PROJECT FLOOD
WITHOUT DAM FAILURE
WITH DAM FAILURE
PEAK FLOOD TIME 3 HRS. 15 MIN 0 HRS 15 MIN
PEAK ELEVATION 744.5 748.8

THE DATUM FO

NORTH

LEGEND

Limit of Standard – Project Flood With Dam Failure

32 — 32 Cross Section

Corporate Limits

2000 0 2000 4000 6000

SCALE IN FEET

Contour interval 10 feet.
National Geodetic vertical datum of 1929.
Source of base map: U. S. Geological Survey 7.5 minute series.
St. Paul West 1967 Photo Revised 1972
Minneapolis South 1967 Photo Revised 1972
Minneapolis North 1967 Photo Revised 1980.

NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the St. Anthony Falls Dams

U.S. ARMY ENGINEERING DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS DAMS EMERGENCY PLAN

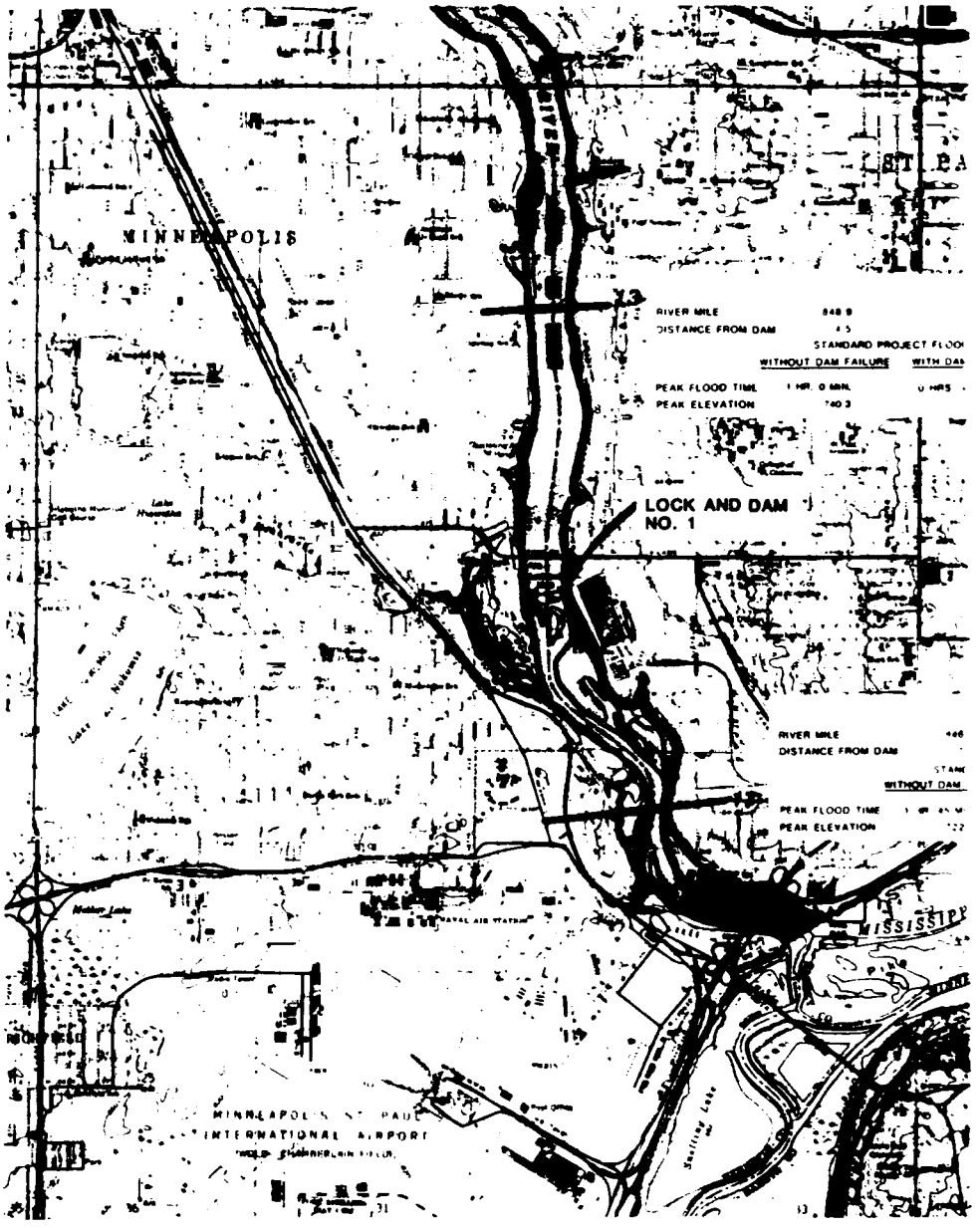
INUNDATION MAP

JUNE 1986

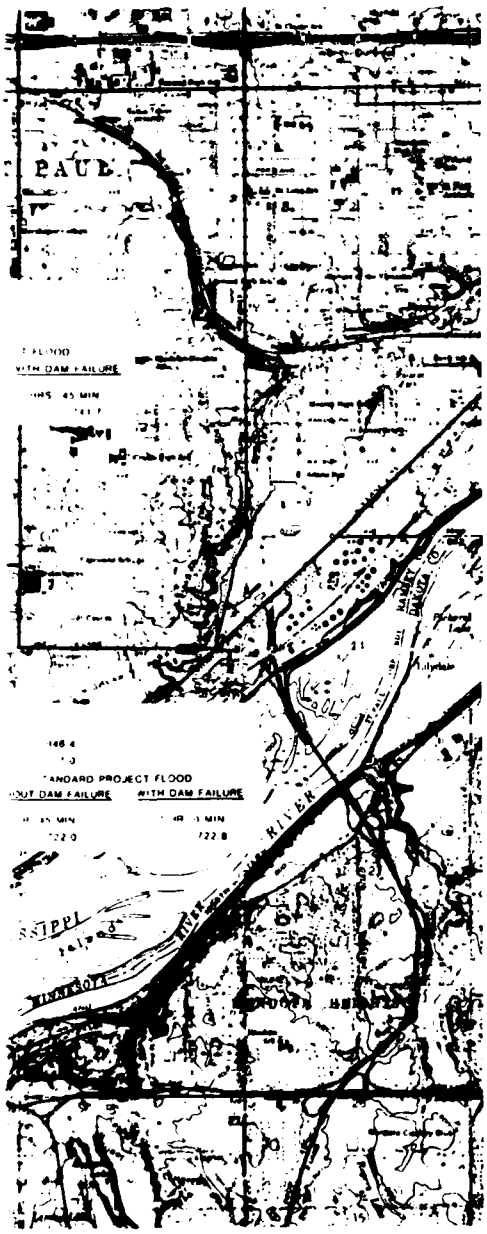
PLATE D-2

TUM FOR THE WATER SURFACE ELEVATIONS IS NGVD 1912

1


MINNEAPOLIS
LOCK AND DAM
NO. 1
MINNEAPOLIS - ST. PAUL
INTERNATIONAL AIRPORT

THE DATUM F



NORTH

LEGEND

Limit of Standard Project Flood With Dam Failure

32 — 32 Cross Section

Corporate Limits

2000 0 2000 4000 6000

SCALE IN FEET

Contour interval 10 feet.
National Geodetic vertical datum of 1929.
Source of base map: U. S. Geological Survey 7.5 minute series St. Paul West 1967 Photo Revised 1972

NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the St. Anthony Falls Dams.

U.S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

ST. ANTHONY FALLS DAMS EMERGENCY PLAN

INUNDATION MAP

JUNE 1986

UM FOR THE WATER SURFACE ELEVATIONS IS NGVD 1912

PLATE D-3